3.0 AFFECTED ENVIRONMENT

This chapter describes the environmental resources at the installations and other locations identified in the Proposed Action—FE Warren, Malmstrom, Minot, Hill, and Vandenberg AFBs; the over-ocean launch corridor; and USAKA. The chapter is organized by installation/location, describing each environmental resource or topical area that could potentially be affected at that site by implementing the Proposed Action. The information and data presented are commensurate with the importance of the potential impacts in order to provide the proper context for evaluating impacts. Sources of data used and cited in the preparation of this chapter include available literature (such as EAs, EISs, and other environmental studies), installation and facility personnel, and regulatory agencies. A rationale for why certain environmental resources are not analyzed further is described in the introductory section for each installation/location.

This information serves as an essential part of the baseline against which the predicted effects of the Proposed Action can be compared. The potential environmental effects of the Proposed Action and No Action Alternative are discussed in Chapter 4.0.

3.1 FE WARREN, MALMSTROM, AND MINOT AIR FORCE BASES

FE Warren AFB is located in southeastern Wyoming, adjacent to the state capital, Cheyenne. Covering approximately 5,870 acres (2,375 hectares), the base currently supports 150 MM III missiles and the remaining Peacekeeper missiles (which are in the process of being deactivated), dispersed over a 12,600-square-mi (32,635-square-km) area covering portions of Wyoming, Nebraska, and Colorado (see Figure 2-3). Located next to the city of Great Falls in north-central Montana, Malmstrom AFB is approximately 4,390 acres (1,775 hectares) in area and supports 200 MM III missiles within a 23,000-square-mi (59,570-square-km) Wing area (see Figure 2-4). With a base area of approximately 5,050 acres (2,045 hectares), Minot AFB is in north-central North Dakota, about 13 mi (21 km) north of the city of Minot. The Wing for Minot supports 150 MM III missiles within an 8,500-square-mi (22,015-square-km) area (see Figure 2-5).

Rationale for Environmental Resources Analyzed

For the proposed MM III modification at FE Warren, Malmstrom, and Minot AFBs, health and safety, and hazardous materials and waste management (including pollution prevention), are the only areas of concern requiring discussion. As for other resource areas not analyzed further, the Proposed Action does not require any ground-disturbing activities; therefore, no impacts to cultural resources, biological resources, or soils would be expected. Only a few existing base personnel would be involved; thus, there are no socioeconomic concerns. Because there would be little or no effect to off-base populations, disproportionate impacts to any minority or low-income populations under Executive Order 12898 (Environmental Justice) would not occur. The proposed activities are well within the limits of current operations and permits at each of the bases. Thus, there would be no effects on airspace, land use, utilities, solid waste management, or transportation; and little or no additional impacts to noise levels, air quality, or water resources.

Because of its long military history dating back to the 1860's, the site of FE Warren AFB includes several buildings and a historic district listed on the National Register of Historic Places (NRHP) (USAF, 2000b). Other more recent ICBM-related facilities at the base and within the Wing area [including most of the

LFs and Missile Alert Facilities[3] (MAFs)] are also eligible for listing on the NRHP because of their Cold War involvement. Under the Proposed Action, none of these facilities would undergo changes to their historic form or function, or result in changes to a piece of scientific architecture. The base has also completed a Historic American Engineering Record for the MM III system, and the museum there has preserved a complete set of LCC equipment and furnishings (Bryant, 2003). Thus, no “adverse effects,” as defined by 36 CFR Part 800 (Protection of Historic Properties), would be expected.

Although MAF A-01 and LF A-06 within the Malmstrom AFB MM Wing are eligible for listing on the NRHP—because of their deterrence role during the Cuban Missile Crisis of 1962 (Ogden ALC, 2003)—neither the facility functions nor the historic property of these sites would be affected under the Proposed Action. These types of facility modifications and upgrades are already addressed in a Programmatic Agreement between the USAF and the Montana State Historic Preservation Office (SHPO) (USAF, 2003). Thus, no consultations with the SHPO are required.

3.1.1 Health and Safety

The region of influence (ROI) for health and safety is limited to the existing missile Wings and base facilities, and the US transportation network used in support of missile operations. Health and safety includes military personnel, contractors, and the general public.

Air Force Policy Directive (AFPD) 91-2 (*Safety Programs*) establishes the USAF’s key safety policies, and also describes success-oriented feedback and performance metrics to measure policy implementation. More specific safety and safety-related DOD Directives (DODDs), Air Force Instructions (AFIs), and other requirements and procedures pertaining to the handling, maintenance, transportation, and storage of nuclear weapons, MM rocket motors, and related ordnance are listed below:

- DODD 3150.2 (*DOD Nuclear Weapon System Safety Program*)
- DODD 5210.41 (*Security Policy for Protecting Nuclear Weapons*)
- DOD 4540.5-M (*DOD Nuclear Weapons Transportation Manual*)
- DOD 6055.9-STD (*DOD Ammunition and Explosives Safety Standards*)
- AFPD 91-1 (*Nuclear Weapons and Systems Surety*)
- AFI 91-101 (*Air Force Nuclear Weapons Surety Program*)
- AFI 91-102 (*Nuclear Weapon System Safety Studies, Operational Safety Reviews, and Safety Rules*)
- AFI 91-114 (*Safety Rules for the Intercontinental Ballistic Missile Systems*)
- AFI 91-116 (*Safety Rules for Storage of Nuclear Weapons*)
- AFI 91-202 (*The US Air Force Mishap Prevention Program*)
- Air Force Manual 91-201 (*Explosives Safety Standards*).

In addition, the individual USAF installations will often augment these requirements to clarify local roles, responsibilities, and authorities by creating supplementary documents or operating instructions. Each Air Force Base’s Safety Division or Office reviews safety issues. For example, the 90th SW Safety Office at FE Warren AFB, the 341st SW Safety Office at Malmstrom AFB, and the 91st SW Safety Office at Minot AFB have these responsibilities.

For the transportation of missile components, interstate highways are the preferred routes, although some state and local routes may be used, depending on the destination. The health and safety of travel on US transportation corridors is under the jurisdiction of each State’s Highway Patrol and DOT, and the US

[3] Each MAF is a relatively small complex consisting of the underground LCC and an aboveground building that houses the personnel and equipment necessary for the facility to operate self-sufficiently.

DOT. The USAF coordinates with each state DOT whenever the transport of hazardous missile components is planned to occur.

The USAF has an excellent safety record of transporting missile rocket motors. During the height of Minuteman Program operations, from the early 1960's to 1990, over 11,000 Minuteman missile movements involving over 12,400 individual Minuteman rocket motors occurred by air, rail, or road. Since 1962, only three accidents have been associated with these movements, all of them transport truck rollover scenarios. In each of these three cases, however, all USAF property was safely recovered and there was no damage to the environment or to human health. In a program in which the USAF transported 150 boosters between 1995 and 1997, there were no traffic incidents. At FE Warren AFB, for example, the accident rate for USAF vehicles in the Wing area (about 0.000002 accidents per mile driven) was shown to be nearly identical to accident rates for the State of Wyoming. (USAF, 1992b, 2000b, 2001b)

3.1.2 Hazardous Materials and Waste Management

For the analysis of hazardous materials and waste management at the MM Wings, the ROI is defined as those USAF facilities on and off base supporting the handling, transportation, and storage of hazardous materials and hazardous waste.

Hazardous materials and waste management activities at USAF installations are governed by specific environmental regulations. For the purposes of the following discussion, the term hazardous materials or hazardous waste refers to those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC Section 9601 et seq., as amended. In general, this includes substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to the public health, welfare, or the environment when released. Regulated under the Resource Conservation and Recovery Act (RCRA), 42 USC Section 6901 et seq., hazardous waste is further defined in 40 CFR 261.3 as any solid waste that possesses any of the hazardous characteristics of toxicity, ignitability, corrosivity, or reactivity.

AFI 32-7042 (*Solid and Hazardous Waste Compliance*) and AFI 32-7086 (*Hazardous Materials Management*) implement AFPD 32-70 (*Environmental Quality*). Each installation provides procedures and guidance to personnel regarding the storage, transportation, use, and disposal of hazardous materials and waste. In accordance with AFI 32-4002 (*Hazardous Materials Emergency Response Program*), each installation also has a plan in place that provides guidelines and instructions to prevent and control accidental spills of hazardous materials, including a description of appropriate countermeasures to contain, clean up, and mitigate the effects of a spill or discharge. These plans and procedures incorporate applicable Federal, state, local, and USAF requirements regarding management of hazardous materials and hazardous waste.

A variety of hazardous materials are utilized and stored at the USAF installations to support the wide range of activities conducted. The installations operate on the pharmacy concept, which allows installation tenants to obtain hazardous materials from assigned distribution centers. Hazardous materials not obtained from the pharmacy must be registered with the pharmacy for tracking purposes. Hazardous waste at each installation is managed in accordance with RCRA requirements. Transportation of hazardous materials and waste is governed by the US DOT regulations within 49 CFR.

3.2 HILL AIR FORCE BASE

Hill AFB is located 5 mi (8 km) south of Ogden, Utah, and about 30 mi (48 km) north of Salt Lake City. As part of its mission, the 6,700-acre (2,710-hectare) installation provides systems management and logistical support for Minuteman, Peacekeeper, and other missile programs. Support for the proposed MM III modification represents routine activities at Hill AFB.

Rationale for Environmental Resources Analyzed

For the proposed MM III system support activities at Hill AFB, health and safety, and hazardous materials and waste management (including pollution prevention), are the only areas of concern requiring discussion. As for other resource areas not analyzed further, the Proposed Action does not require any ground-disturbing activities; therefore, no impacts to cultural resources, biological resources, or soils would be expected. Only a few existing base personnel would be involved; thus, there are no socioeconomic concerns. Because there would be little or no effect to off-base populations, disproportionate impacts to any minority or low-income populations under Executive Order 12898 (Environmental Justice) would not occur. The proposed activity is well within the limits of current operations and permits at Hill AFB. As a result, there would be no effects on airspace, land use, utilities, solid waste management, or transportation; and little or no additional impacts to noise levels, air quality, and water resources.

3.2.1 Health and Safety

Regarding health and safety at Hill AFB, the ROI is limited to existing base facilities, and US transportation networks used in support of missile operations. Safety responsibilities at Hill AFB fall under the Ogden Air Logistics Safety Office. As noted in Section 3.1.1, safety managers use DOD requirements, the AFPD-91 series, AFI-91 series, and applicable Federal and state regulations to implement the safety program.

As described in Section 3.1.1, interstate highways are the preferred routes for the transport of rocket motors, although some state and local routes may be used, depending on the destination. The health and safety of travel on US transportation corridors is under the jurisdiction of each State’s Highway Patrol and DOT, the US DOT, and the DOD. The USAF coordinates on a regular basis with each state DOT whenever rocket motor transport is planned to occur. As previously discussed, the USAF has an excellent safety record of transporting missile boosters and rocket motors.

3.2.2 Hazardous Materials and Waste Management

Hazardous materials and waste management activities at Hill AFB are governed by the same specific environmental regulations identified in Section 3.1.2. The ROI is limited to the existing facilities at Hill AFB that handle hazardous materials; and collect, store (on a short-term basis), and ship hazardous waste.

3.3 VANDENBERG AIR FORCE BASE

Vandenberg AFB is located in Santa Barbara County on the central coast of California, about 150 mi (240 km) northwest of Los Angeles. Covering more than 98,000 acres (39,660 hectares), it is the third-largest USAF installation. A primary mission for the base is to conduct and support space and missile launches. With its location along the Pacific coast, Vandenberg AFB is the only facility in the United States from which unmanned Government and commercial satellites can be launched into polar orbit, and land-based ICBMs are launched to verify weapon system performance.

Rationale for Environmental Resources Analyzed

For the proposed MM III modification activities at Vandenberg AFB, air quality, noise, biological resources, health and safety, and hazardous materials and waste management (including pollution prevention) are the only areas of concern requiring discussion. Surface water quality was also included in the analysis, from the standpoint of potential impacts on vegetation and wildlife. No other environmental resource areas are analyzed further for the following reasons. The Proposed Action does not require any ground-disturbing activities; therefore, no impacts to cultural resources or soils would be expected. Although eligible for listing on the NRHP under Cold War criteria (USAF, 1997a), none of the LFs used for conducting MM III launches would require modifications or changes in their current use. Installation Restoration Program (IRP) studies on base have not shown any concerns for contamination to soils or groundwater from prior launches in the Minuteman Launch Area (VAFB, 2003c). There would be little or no increase in personnel on base; thus, there are no socioeconomic concerns. Although missile launches would affect off-base populations, primarily from launch noise, the effects would occur over a wide area and would not result in disproportionate impacts to minority or low-income populations under Executive Order 12898 (Environmental Justice). With the ability for Vandenberg AFB to schedule restricted military airspace over the base and ocean range, there would be little concern for potential impacts on airspace during the proposed MM III missile launches. The proposed flight tests represent activities well within the limits of current operations and permits at Vandenberg AFB. As a result, there would be no adverse effects on land use, utilities, solid waste management, or transportation.

3.3.1 Air Quality

In California, air quality is assessed on a county and a regional basis. Air quality at Vandenberg AFB is regulated by the Santa Barbara County Air Pollution Control District (SBCAPCD), the California Air Resources Board (CARB), and Region IX of the US Environmental Protection Agency (USEPA). Stationary sources of air emissions on base typically include abrasive blasting operations, boilers, generators, surface coating operations, turbine engines, wastewater treatment plants, storage tanks, aircraft operations, soil remediation, launch vehicle fueling operations, large aircraft starting system, and solvent usage. Mobile sources at the base that result in air emissions include various aircraft, missile and spacecraft launches, and numerous Government and personal motor vehicles. (VAFB, 2000a)

For analysis purposes, the ROI for inert air pollutants (all pollutants other than ozone and its precursors) is generally limited to an area extending no more than a few miles downwind from the source. The ROI for ozone and its precursors, however, may extend much further.

The Federal Clean Air Act (CAA) authorizes the USEPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health. Standards for six criteria pollutants [i.e., ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), inhalable particulate matter (PM_{10} and $PM_{2.5}$), and lead particles] have been adopted. Table 3-1 shows ambient concentrations of the criteria pollutants as measured by monitoring stations located near the southern end of Vandenberg AFB and in the nearby community of Santa Maria. The CARB classifies areas of the state that are in attainment or nonattainment for the California Ambient Air Quality Standards (CAAQS). Both the USEPA and CARB have designated Santa Barbara County as being in attainment of the NAAQS and CAAQS for SO_2, NO_2, and CO. As the data in Table 3-1 demonstrates, the county area is in attainment with the Federal PM_{10} standard, but has been designated by the CARB to be in nonattainment with the more stringent California standard for PM_{10}. Although Federal and state standards for $PM_{2.5}$ have been set, area designations in terms of attainment and nonattainment were not expected until December 2004 (California ARB, 2004). Santa Barbara County as a whole does not meet the state ozone standard and has only recently, and by a small margin, attained the Federal ozone standard. (SBCAPCD, 2003)

Prior Vandenberg AFB emission inventory results show that missile launch emissions account for less than one percent of the total PM_{10} and total CO emissions. Since 1991, all new stationary sources of

Table 3-1. Air Quality Standards and Ambient Air Concentrations at or near Vandenberg AFB, California									
Pollutant	**2000**		**2001**		**2002**		**California Standards[1]**	**Federal Standards[2]**	
	South VAFB	**Santa Maria**	**South VAFB**	**Santa Maria**	**South VAFB**	**Santa Maria**		**Primary[3]**	**Secondary[4]**
Ozone (ppm)									
1-hour highest[5]	0.081	0.066	0.079	0.064	0.084	0.065	0.09	0.12	Same as Primary Standard
1-hour 2nd highest	0.078	0.065	0.076	0.063	0.079	0.064	-	-	-
8-hour highest[6]	0.069	0.058	0.070	0.058	0.078	0.059	-	0.08	Same as Primary Standard
8-hour 2nd highest	0.064	0.057	0.065	0.053	0.067	0.049	-	-	-
CO (ppm)									
1-hour highest	1.0	4.0	0.7	3.5	1.3	3.1	20	35	-
1-hour 2nd highest	0.7	3.3	0.7	2.8	1.1	2.4	-	-	-
8-hour highest	0.5	2.1	0.6	1.3	0.8	1.2	9	9	-
8-hour 2nd highest	0.5	1.9	0.6	1.1	0.6	1.2	-	-	-
NO_2 (ppm)									
1-hour highest	0.033	0.049	0.049	-	0.014	0.052	0.25	-	-
1-hour 2nd highest	0.028	0.048	0.047	-	0.009	0.048	-	-	-
Annual Arithmetic Mean	0.003	0.010	0.003	-	0.003	0.011	-	0.053	Same as Primary Standard
SO_2 (ppm)									
1-hour highest	0.004	-	0.004	-	0.006	-	0.25	-	-
1-hour 2nd highest	0.004	-	0.003	-	0.006	-	-	-	-
3-hour highest	0.002	-	0.002	-	0.002	-	-	-	0.50
3-hour 2nd highest	0.002	-	0.002	-	0.002	-	-	-	-
24-hour highest	0.001	-	0.001	-	0.001	-	0.04	0.14	-
24-hour 2nd highest	0.001	-	0.001	-	0.001	-	-	-	-
Annual Arithmetic Mean	0.001	-	0.001	-	0.001	-	-	0.03	-
PM_{10} ($\mu g/m^3$)									
24-hour highest	48	53	45	66	50	48	50	150	Same as Primary Standard
24-hour 2nd highest	42	53	44	56	45	40	-	-	-
Annual Arithmetic Mean	19	26	19	27	19	24	20	50	Same as Primary Standard

Table 3-1. Air Quality Standards and Ambient Air Concentrations at or near Vandenberg AFB, California

Pollutant	2000		2001		2002		California Standards[1]	Federal Standards[2]	
	South VAFB	Santa Maria	South VAFB	Santa Maria	South VAFB	Santa Maria		Primary[3]	Secondary[4]
$PM_{2.5}$ (µg/m^3)									
24-hour highest	-	28.7	-	43.2	-	21.3	-	65	Same as Primary Standard
24-hour 2nd highest	-	19.3	-	23.4	-	19.4	-	-	-
Annual Arithmetic Mean	-	9.77	-	10.40	-	9.52	12	15	Same as Primary Standard

Notes:

[1] California standards for ozone, carbon monoxide, sulfur dioxide (1-hour and 24-hour), nitrogen dioxide, and particulate matter are not to be exceeded values.

[2] National averages (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year, with a maximum hourly average concentration above the standard, is equal to or less than one.

[3] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[4] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects from a pollutant.

[5] Not to be exceeded on more than an average of 1 day per year over a 3-year period.

[6] Not to be exceeded by the 3-year average of the annual 4th highest daily maximum 8-hour average.

Sources: California ARB, 2003; Cordes, 2004; SBCAPCD, 2003; USEPA, 2003 (Note: SBCAPCD data was used when SBCAPCD and USEPA data was contradictory for the same pollutant measure.)

emissions (and modifications) at Vandenberg AFB have applied best available technology and offset emissions at a 1.2 to 1.0 ratio. Table 3-2 lists total annual emissions from Vandenberg AFB and Santa Barbara County.

Table 3-2. Vandenberg AFB and Santa Barbara County Total Annual Air Emissions

Emissions Source	Pollutant (tons/year)				
	VOC	NO_x	CO	SO_X	PM_{10}
2001 Emissions from Vandenberg AFB (estimated)	5.0	19.6	51.8	1.1	64.6
1999 Emissions from Santa Barbara County	44,605	19,234	95,227	1,594	9,253

Source: SBCAPCD/SBCAG, 2002; USASMDC, 2003b

For the purpose of this EA, "lower atmosphere" refers to the troposphere, which extends from ocean level to an altitude of approximately 32,800 ft (10 km). "Upper atmosphere" refers to the stratosphere, which extends from 32,800 ft (10 km) to approximately 164,000 ft (50 km) in altitude. (NOAA, 2001)

The stratosphere contains the Earth's ozone layer, which varies as a function of latitude and season. The ozone layer plays a vital role in absorbing harmful ultraviolet radiation from the sun. Over the past 20 years, concentrations of ozone in the stratosphere have been threatened by anthropogenic (human-made) gases released into the atmosphere. Such gases include chlorofluorocarbons (CFCs), which have been widely used in electronics and refrigeration systems, and the lesser used Halons, which are extremely effective fire extinguishing agents. Once released, the CFCs and Halons are mixed worldwide by the motions of the atmosphere until, after 1 to 2 years, they reach the stratosphere, where they are broken down by ultraviolet radiation. The chlorine and bromine atoms, within the respective CFC and Halon gas molecules, are released and directly attack ozone molecules, depleting them. (NOAA, 2001; WMO, 1998)

Through global compliance with the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, and its later amendments, the worldwide production of CFCs and other ozone-depleting substances has been drastically reduced, and banned in many countries. A continuation of these compliance efforts is expected to allow for a slow recovery of the ozone layer. (WMO, 1998)

There is also a growing concern regarding the potential effects of greenhouse gases on global climate. Greenhouse gases are largely transparent to solar radiation, but they do absorb long-wave radiation emitted by the earth's surface and re-radiate a portion of the energy back down to earth. This process results in a net warming effect to the lower layers of the atmosphere. Many gases exhibit "greenhouse" properties, including those that occur naturally in the atmosphere, such as water vapor, carbon dioxide, methane, and nitrous oxide; and those that are anthropogenic, such as CFCs, hydrofluorocarbons, and perfluorocarbons. Within the United States, nearly 85 percent of anthropogenic greenhouse gas emissions come from the burning of fossil fuels. (DOE, 2002)

3.3.2 Noise

Noise is most often defined as unwanted sound that is heard by people or wildlife and interferes with normal activities or otherwise diminishes the quality of the environment. Sources of noise may be transient (e.g., a passing train or aircraft), continuous (e.g., heavy traffic or air conditioning equipment), or impulsive (e.g., a sonic boom or a pile driver). Sound waves traveling outward from a source exert a sound pressure measured in decibels (dB).

The human ear is not equally sensitive to all sound wave frequencies. Sound levels adjusted for frequency-dependent amplitude are called "weighted" sound levels. Weighted measurements emphasizing frequencies within human sensitivity are called A-weighted decibels (dBA). Established by the American National Standards Institute, A-weighting significantly reduces the measured pressure level for low-frequency sounds, while slightly increasing the measured pressure level for some high-frequency sounds. Typical A-weighted sound levels measured for various sources are provided in Figure 3-1.

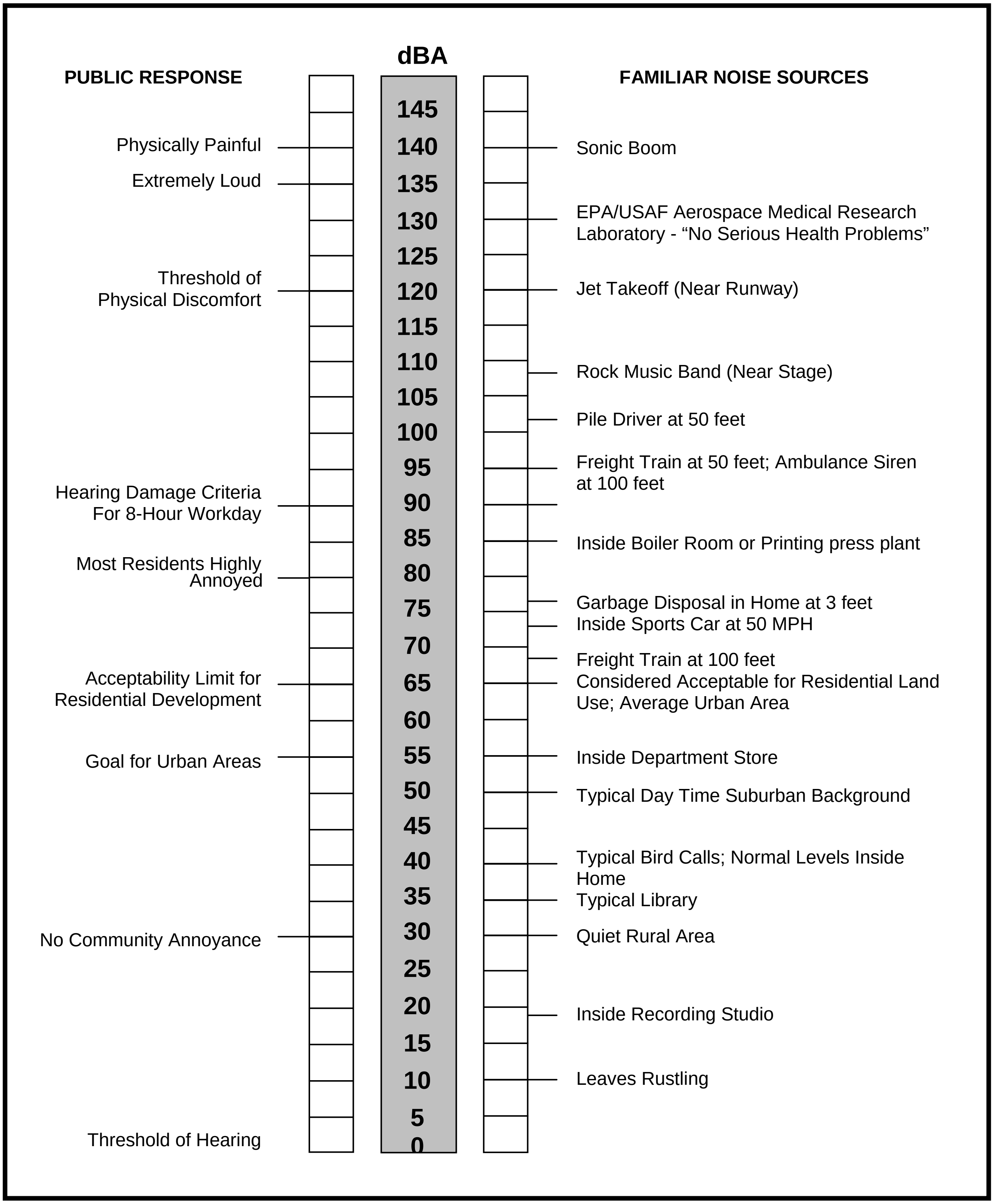
USAF standards currently require hearing protection whenever a person is exposed to steady state noise of 85 dBA or more, or impulse noise of 140 dB sound pressure level or more, regardless of duration. Use of any noise hazardous machinery, or entry into hazardous noise areas, requires personal noise protection. Air Force Occupational Safety and Health (AFOSH) Standard 161-20 and the AFI 48-20 Interim Guidance describe the USAF Hearing Conservation Program procedures used at Vandenberg AFB. Similarly, under 29 CFR 1910.95, employers are required to monitor employees whose exposure to noise could equal or exceed an 8-hour time-weighted average of 85 dBA. For off-base areas, Vandenberg AFB follows state regulations concerning noise, and maintains a Community Noise Equivalent Level (CNEL) of 65 dBA or lower. CNELs represent day-night noise levels averaged over a 24-hour period, with "penalty" decibels added to quieter time periods (i.e., evening and nighttime). As a result, the CNEL is generally unaffected by the short and infrequent rocket launches occurring locally on base.

For noise analysis purposes in this EA, the ROI at Vandenberg AFB is defined as the area within the 80-dB maximum (unweighted) sound level contours generated by proposed project activities.

Noise at Vandenberg AFB is typically produced by automobile and truck traffic, aircraft operations (approximately 32,000 per year, including landings, takeoffs, and training approaches and departures for both fixed-wing and rotary-wing aircraft), and Southern Pacific trains passing through the base (an average of 10 trains per day) (VAFB, 2000a). Existing noise levels on Vandenberg AFB are generally low, with higher levels occurring near industrial facilities and transportation routes.

The immediate area surrounding Vandenberg AFB is largely composed of undeveloped and rural land, with some unincorporated residential areas in the Lompoc and Santa Maria valleys, and Northern Santa Barbara County. The cities of Lompoc and Santa Maria, which make up the two main urban areas in the region, support a small number of industrial areas and small airports. Sound levels measured for the area are typically low, except for higher levels in the industrial areas and along transportation corridors. The rural areas of the Lompoc and Santa Maria valleys typically have low overall CNELs, normally about 40 to 45 dBA (USAF, 1998). Occasional aircraft flyovers can increase noise levels for a short period of time.

Other less frequent, but more intense, sources of noise in the region are from missile and space launches at Vandenberg AFB. These include MM III, Peacekeeper, and Delta II launches from the North Base area; and Minotaur launches, and future Atlas V and Delta IV launches, from the South Base area. Depending on the launch vehicle and launch location on the base, resulting noise levels in Lompoc and Santa Maria may reach estimated maximum unweighted sound pressure levels of 100 dB and 95 dB, respectively, and have an effective duration of about 20 seconds per launch. Equivalent A-weighted sound levels would be lower. Because launches from Vandenberg AFB occur infrequently, and the launch noise generated from each event is of very short duration, the average (CNEL) noise levels in the nearby areas are not affected. (USAF, 1997c, 1998, 2000a)



Source: Modified from USASDC, 1991

Figure 3-1. Typical Noise Levels of Familiar Noise Sources and Public Responses

Although rocket launches from Vandenberg AFB often produce sonic booms during the vehicle's ascent, the resulting overpressures are directed out over the ocean in the direction of the launch azimuth and generally do not affect the California coastal area.

3.3.3 Biological Resources

For purposes of analyzing biological resources at Vandenberg AFB, the ROI includes all of the base property from Point Sal to just south of Shuman Creek, including near-shore waters (see Figure 3-2).

Threatened, Endangered, and Other Protected Species

Vegetation. Vandenberg AFB supports a wide variety of vegetation types that are considered sensitive, including Bishop pine forest, Burton mesa chaparral, coastal dune scrub, coastal sage scrub, salt marsh, native grassland, freshwater marsh, tanbark oak forest, vernal pools, riparian willow shrublands, and seasonal wetlands. Approximately 85 percent of Vandenberg AFB vegetation is natural, with the balance either invasive vegetation that has replaced natural flora, particularly non-native annual grasslands, or plants associated with developments. (USAF, 1991b; VAFB, 2000a)

The ROI is dominated by coastal sage scrub, annual non-native grassland, and coastal dune scrub. Most of the vegetation around the Minuteman launch facilities, particularly in areas cleared to reduce fire hazard, may be characterized as non-native grassland. Vandenberg AFB continues to be an important refuge for sensitive plant species, because human activities and invasive species are controlled on the base.

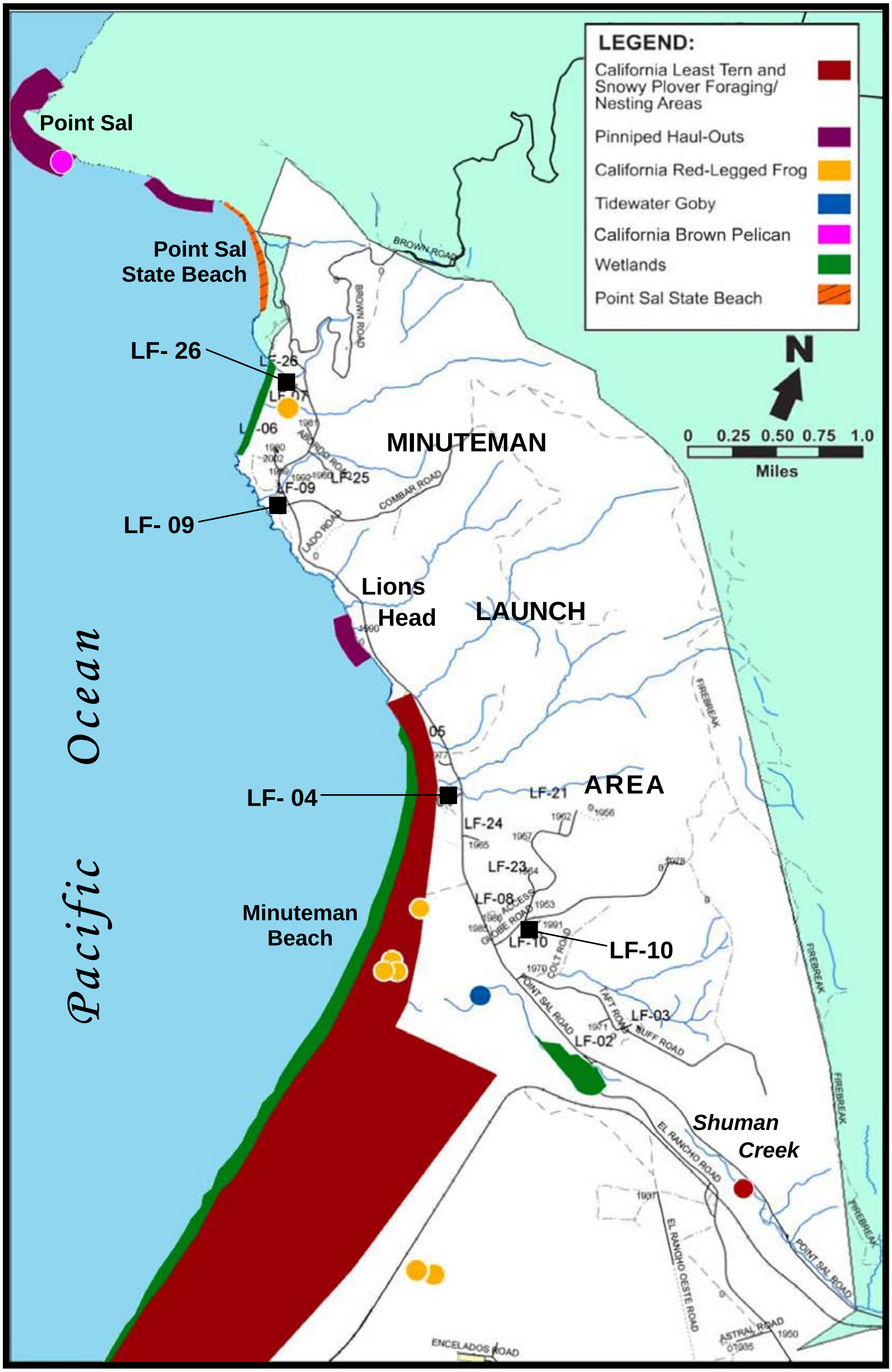
Although four Federally listed sensitive plant species are found on Vandenberg AFB, the Gaviota tarplant [*Deinandra (=Hemizonia) increscens ssp. villosa*] is the only one occurring within the ROI (VAFB, 2000a). The Gaviota tarplant is found only within a narrow band of coastal terrace grassland between the cities of Gaviota and Santa Barbara, California (USEPA, 2001), and was designated an endangered species throughout its range in March 2000 (65 FR 14888-14898). On Vandenberg AFB, it can be found at two locations; one of these locations is southeast of LF-06 in the Minuteman Launch Area (USAF, 1999; VAFB, 2000b).

Wildlife Species. Those listed and protected wildlife species occurring within the ROI are identified in Table 3-3.

The terrestrial environment of the Minuteman Launch Area is characterized by dry, steep slopes covered with annual grassland and coastal sage scrub. However, the larger drainages hold water for enough of the year to support an endangered fish, the tidewater goby (*Eucyclogobius newberryi*), and the threatened California red-legged frog (*Rana aurora draytonii)*.

The tidewater goby is a benthic species found in shallow lagoons, tidal wetlands, and the mouths of streams, tolerating fresh or brackish water year-round. Within the ROI, it has been found only in the outflow of Shuman Creek (see Figure 3-2). It also occurs in San Antonio Creek, immediately south of the ROI. Stringent land use constraints apply wherever it occurs (VAFB, 2000a).

The California red-legged frog prefers freshwater pools and ponds with arroyo willow (*Salix lasiolepis*), cattails (*Typha* ssp.), and other thick emergent aquatic vegetation (USAF, 1995). In March 2001, the USFWS designated 4.1 million acres (1.6 million hectares) in 28 California counties as critical habitat for the frog, but excluded Vandenberg AFB because its Integrated Natural Resource Management Plan (VAFB, 1997a) provided adequate management for the on-base population (Jumping Frog Research



Source: Collier et al., 2002; Robinette and Sydeman, 1999; Roest, 1995; USAF, 1997c; VAFB, 2000a, 2003a

Figure 3-2. Sensitive Habitat and Protected Species within the Minuteman Launch Area at Vandenberg AFB, California

Table 3-3. Threatened, Endangered, and Other Protected Species Occurring at Vandenberg AFB, California			
Common Name	**Scientific Name**	**Federal Status**	**California Status**
Plants			
Gaviota tarplant	*Deinandra increscens ssp. villosa*	E	E
Fish			
Tidewater goby	*Eucyclogobius newberryi*	E	SSC
Reptiles/Amphibians			
California red-legged frog	*Rana aurora draytonii*	T	SSC
Birds			
California brown pelican	*Pelacanus occidentalis californicus*	E	E
Western snowy plover	*Charadrius alexandrinus nivosus*	T	SSC
California least tern	*Sterna antillarum browni*	E	E
Bald eagle	*Haliaeetus leucocephalus*	PD, T	E
American peregrine falcon	*Falco peregrinus anatum*	D	E
Western burrowing owl	*Speotyto cunicularia hypugea*	-	SSC
Marine Mammals (haul-out sites & nearshore waters)			
Guadalupe fur seal	*Arctocephalus townsendi*	T	T
Northern fur seal	*Callorhinus ursinus*	MMPA	-
California sea lion	*Zalophus californianus*	MMPA	-
Steller sea lion	*Eumetopias jubatus*	T	-
Harbor seal	*Phoca vitulina richardsi*	MMPA	-
Elephant seal	*Mirounga angustirostris*	MMPA	-
Southern sea otter	*Enhydra lutris nereis*	T	-

Notes:
E = Endangered
T = Threatened
SSC = Species of Special Concern
CE, CT = State Candidate Endangered and Threatened Species
PE, PT = Federal Proposed Endangered and Proposed Threatened Species
MMPA = Protected under the Marine Mammal Protection Act
D, PD = Delisted or Proposed for Delisting

Institute, 2001). Within the ROI, the red-legged frog occurs in Shuman Creek and the outflow of small drainages within a few hundred yards of LF-26 (Figure 3-2). Stringent land use constraints apply to these areas (VAFB, 2000a).

Raptorial birds with Federal and state status have been found within the ROI and are listed in Table 3-3. A sighting of the American peregrine falcon (*Falco peregrinus anatum*) was documented in 1989 in the Point Sal area. This raptor has been the subject of an active state reintroduction program since the 1970's (USAF, 1990), leading to its delisting at the Federal level in 1999 (64 FR 46541-46558). The bald eagle (*Haliaeetus leucocephalus*), listed at both state and Federal levels and protected by special legislation [Bald Eagle Protection Act (16 U.S.C. 668-668d, as amended)], has rarely been sighted on base. No bald eagle nesting sites are known to exist within the ROI. A California Species of Special Concern, the western burrowing owl (*Speotyto cunicularia hypugea*) has been sighted within the ROI, but only as a winter transient or migrant, and never in significant numbers (USAF, 1998; VAFB, 1997b). Golden eagles (*Aquila chrysaetos*) are not listed, but are protected from exploitation under the Bald Eagle Protection Act. They may be sighted anywhere on the base, but are not common, and none are known to nest within the ROI (USAF, 1997c; VAFB, 2000b).

Because Vandenberg AFB is near the southern limit of the breeding ranges for many seabird species, a long-term program was begun in 1999 to monitor population dynamics and breeding biology of seabirds breeding on the base annually. An estimated total of 1,200 seabirds were identified in 1999 (Robinette and Sydeman, 1999). Three listed seabirds have been found within the ROI. The endangered California brown pelican (*Pelecanus occidentalis californicus*) roosts on rocks offshore of Point Sal (Figure 3-2) (Collier, et al., 2002). Shuman Creek offers foraging habitat for the endangered California least tern (*Sterna antillarum brownii*) (Robinette and Sydeman, 1999). Least terns have also been seen nesting at Purisima Point just a few miles south of the Minuteman Launch Area. The western snowy plover (*Charadrius alexandrinus nivosus*) also nests on the coastal dunes of Minuteman Beach as far north as LF-04 (Robinette and Sydeman, 1999; VAFB, 2003a).

Regarding marine mammals, several protected or listed species of seals and sea lions (pinnipeds) are found within the ROI. They use beaches and rocky shores on the coast of Vandenberg AFB to rest, molt, or breed. Pinnipeds that may be found onshore ("hauled-out") within the ROI include the California sea lion (*Zalophus californianus*), Pacific harbor seal (*Phoca vitulina*), northern elephant seal (*Mirounga angustirostris*), and northern fur seal (*Callorhinus ursinus*). None of these species are listed as endangered or threatened, but all enjoy Federal protection from harassment or injury under the Marine Mammal Protection Act (MMPA). Two other pinniped species, the Guadalupe fur seal (*Arctocephalus townsendi*) and Steller sea lion (*Eumetopias jubatus*), are Federally listed as threatened, but are rare visitors at the base. There have been no land or near-shore sightings of Steller sea lions in the region since 1984 (Roest, 1995; 64 FR 9925-9932; 69 FR 5720-5728).

The Pacific harbor seal is found in the ROI year-round. Lions Head has been documented as a haul-out and recently as a pupping area for a small number of seals. It is the closest haul-out site to the Minuteman LFs (Figure 3-2). The highest animal counts at Lions Head, which averages 20 seals, are made between September and January during the post-breeding period. Pupping occurs in March, followed by a 4- to 6-week weaning period (Roest 1995; USAF, 1999). Harbor seals are considered particularly sensitive to disturbance during this period, when the risk of mother-offspring separation is greatest.

The California sea lion does not breed on Vandenberg AFB, but is found along the coastline during the summer (USAF, 1999). Point Sal, which is a little over a mile northwest of the base boundary (Figure 3-2), is the closest area used as a haul-out by California sea lions.

Elephant seals and northern fur seals are observed periodically on Vandenberg AFB, preferring undisturbed sections of mainland coast and offshore islands or rocks, such as at Lions Head (USAF, 1997c).

One other marine mammal occurs in close proximity to the Minuteman Launch Area, just off shore. The Federally threatened southern sea otter (*Enhydra lutris nereis*) can be observed foraging and rafting within a few hundred yards of the shore anywhere kelp beds can be found. Breeding and pupping have been observed in the area of Purisima Point (Figure 2-9) to the south (Roest, 1995; USAF, 1999). Semi-migratory individual otters also have been found in the kelp beds near Point Sal (Figure 3-2) (Friends of the Sea Otter, 2002).

Environmentally Sensitive and Critical Habitats

In cooperation with the USFWS and The Nature Conservancy, Vandenberg AFB has identified endangered, threatened, and sensitive habitats for special protection under its Integrated Natural Resources Management Plan (VAFB, 1997a). Those habitat areas found within the ROI are summarized in the following paragraphs.

The installation contains a major southern California coastal dune system that is unusually well preserved. Extensive central foredunes and coastal dune scrub are found on the North Vandenberg coast as far north as LF-04 (USAF, 1991a).

Wetlands on Vandenberg AFB support wildlife, act as water filters, and absorb floodwater runoff. Although the major wetland areas on the base occur south of the ROI, a number of small tidal wetlands are along the Minuteman Beach shoreline (Figure 3-2). A few non-tidal wetlands, ranging between 2 and 7 acres (0.8 and 2.8 hectares) in size, can also be found in the Minuteman Launch Area, supporting such typical plant species as the arroyo willow, wide-leaf cattail, California bulrush, water smartweed, and bog rush. The Shuman Creek drainage and pools are the most important of these, but even small seasonal pools at the mouths of drainages on coastal bluffs can harbor endangered wildlife. Brackish pools occur at least seasonally along the margin of Minuteman Beach, fed by both runoff from small drainages and ocean waves at high tide.

Although no USFWS designated critical habitat areas have been established on base for the Gaviota tarplant, Vandenberg AFB has made a commitment to develop and implement protective measures to be specified in its updated Integrated Natural Resources Management Plan, which is currently in revision. These measures may include establishing Sensitive Resource Protection Areas; and monitoring, survey, enhancement, and restoration activities (USFWS, 2002; VAFB, 2000a). The USFWS has also designated critical habitat for nesting snowy plovers along the beaches of Vandenberg AFB, coordinating beach closures during the snowy plover nesting season (March 1 through September 30).

Essential Fish Habitat

The Sustainable Fisheries Act (Public Law 104-297) requires regional Marine Fisheries Councils to manage fisheries to ensure stability of fish populations with support from the NMFS. Regional Marine Fisheries Councils prepare Fishery Management Plans (FMPs) that identify and protect the habitat essential to maintain healthy fish populations. Commercially important species are preferentially targeted. Threats to habitat from both fishery and non-fishery activities are identified and actions needed to eliminate them are recommended. In California, the Pacific Marine Fishery Council (PMFC) is responsible for identifying essential fish habitat (EFH).

Fishes of commercial importance found just within and downrange from the ROI include coastal pelagic schooling squids and fishes (Pacific sardine and mackerel, northern anchovy, and jack mackerel), groundfish (rockfish, shark, and cod), and large, highly migratory pelagic fishes (tuna, marlin, and swordfish). EFH identified by the PMFC for these species includes all marine and estuary waters from the coast of California to the limits of the Exclusive Economic Zone, the 200 mi (322 km) limit. Groundfish are the species of commercial importance found within the shallow waters off Vandenberg AFB. Eighty-three species of groundfish are identified in the FMP for this region (WPRFMC, 2003).

3.3.4 Health and Safety

Regarding health and safety at Vandenberg AFB, the ROI is limited to existing base facilities, off-base areas within launch hazard zones, and areas downrange along the missile flight path. Health and safety requirements at Vandenberg AFB include industrial hygiene, which is the joint responsibility of Bio-Environmental Services and the 30th Space Wing (SW) Safety Office. These responsibilities include monitoring of worker exposure to workplace chemicals and physical hazards, hearing and respiratory protection, medical monitoring of workers subject to chemical exposures, and oversight of all hazardous or potentially hazardous operations. Ground safety includes both occupational and public safety. As noted in Section 3.1.1, safety managers use DOD requirements, the AFPD-91 series, AFI-91 series, and applicable Federal and state regulations to implement the safety program.

The 30th SW Commander, Chief of Safety, Flight Analysis, and the Mission Control Officer are responsible for ensuring safety during ballistic and space launches at Vandenberg AFB. Responsibility and final authority of the safe conduct of ballistic and space vehicle operations lies with the 30th SW Commander. Establishing and managing the overall safety program at Vandenberg AFB is the responsibility of the 30th SW Safety Office. (USAF, 1999)

The Eastern and Western Range (EWR) 127-1 (*Range Safety Requirements*) establishes range safety policy, and defines requirements and procedures for ballistic and space vehicle operations at Vandenberg AFB. Over-ocean launches must comply with DOD Directive 4540.1 (*Use of Airspace by US Military and Firings Over the High Seas*).

Prior to conducting missile flight tests, all missile operations are evaluated by the 30th SW Safety Office. For operations involving such testing, an evaluation is made to ensure that populated areas, critical range assets, and civilian property susceptible to damage are outside predicted impact/debris limits. This includes a review of missile trajectories and hazard area dimensions, review and approval of destruct systems, and atmospheric dispersal modeling to ensure emission concentrations from each launch do not exceed certain levels outside controlled areas. In accordance with 30th Space Wing Instruction (SWI) 91-106 (*Toxic Hazard Assessments*), if hydrogen chloride launch emission cloud concentrations of 10 parts per million (ppm) or higher are predicted to cross outside the base land boundary, the launch is held until meteorological conditions improve.

A NOTMAR and a NOTAM are published and circulated in accordance with 30th SWI 91-104 (*Operations Hazard Notice*) to provide warning to personnel (including recreational users of the range space and controlled sea areas) concerning any potential impact areas that should be avoided. Radar and visual sweeps of hazard areas by helicopter are accomplished prior to operations to ensure evacuation of non-critical personnel. This includes the closure of nearby access roads and the evacuation of Point Sal State Beach (just north of LF-26) on average two times per year, under agreement with Santa Barbara County (VAFB, 2003b); and the coordination and monitoring of any train traffic passing through the base within a mile south of LF-10, consistent with 30th SWI 91-103 (*Train Hold Criteria*).

Vandenberg AFB possesses significant emergency response capabilities that include its own Fire Department, Disaster Control Group, and Security Police Force, in addition to contracted support for handling accidental releases of regulated hypergolic propellants and other hazardous substances.

The Vandenberg AFB Fire Department approves and maintains the business plans and hazardous material inventories prescribed by the California Health and Safety Code, which are developed by organizations assigned to or doing business on the base. Additionally, the base Fire Department conducts on-site facility inspections, as required, to identify potentially hazardous conditions that could lead to an accidental release. During launch operations, Fire Department response elements are pre-positioned to expedite response in the event of a launch anomaly. (USASMDC, 2002)

3.3.5 Hazardous Materials and Waste Management

Hazardous materials and waste management activities at Vandenberg AFB are governed by the same environmental regulations identified in Section 3.1.2. The ROI is limited to the existing facilities at Vandenberg AFB that handle hazardous materials; and collect, store (on a short-term basis), and ship hazardous waste.

Hazardous materials obtained from off base suppliers are coordinated through Vandenberg AFB's Hazmart Pharmacy. Hazardous materials are inventoried and tracked using Environmental Management System software. These procedures are in accordance with the base *Hazardous Materials Management Plan* (30th SW Plan 32-7086).

Any spills of hazardous materials are handled under Vandenberg's *Hazardous Materials Emergency Response Plan* (30th SW Plan 32-4002-A). This plan ensures that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to all installation personnel.

For hazardous waste, the base *Hazardous Waste Management Plan* (30th SW Plan 32-7043-A) describes the procedures for packaging, handling, transporting, and disposing of such wastes. If not reused or recycled, hazardous wastes are transported off base for appropriate treatment and disposal.

3.4 OVER-OCEAN LAUNCH CORRIDOR

This section describes the baseline conditions within the Pacific over-ocean launch corridor that may be affected by the proposed MM III missile launch and flight activities.

Rationale for Environmental Resources Analyzed

Because of the limited scope of the Proposed Action in the over-ocean launch corridor, only biological resources were analyzed. Water quality and noise were also included in the analysis, from the standpoint of potential impacts on marine life. For purposes of this analysis, the ROI is focused primarily on that segment of the Pacific launch corridor out 1,000 mi (1,610 km) from the California coast, and in the vicinity of the Marshall Islands, where missile drop zones occur (see Figures 2-10 and 2-12).

Other environmental resources within the ROI were not evaluated in this EA for the following reasons. With effects limited to the over-ocean corridor, there is no potential for impacts to cultural resources, land use, soils, and groundwater. Similarly, since the ROI is well removed from islands and population centers, no impacts to the human noise environment, socioeconomics, utilities, waste management, or transportation are anticipated, nor are environmental justice concerns expected. Potential effects of launch emissions on the upper atmosphere are covered in the sections for Vandenberg AFB (Sections 3.3.1 and 4.3.1). Health and safety-related issues in the launch corridor are addressed under Vandenberg AFB (Sections 3.3.4 and 4.3.4) and USAKA (Sections 3.5.3 and 4.5.3).

3.4.1 Biological Resources

The affected environment of the ocean area is described below in terms of its physical and chemical properties, biological diversity, threatened and endangered species, and other marine mammals.

Physical and Chemical Properties

The general composition of the ocean includes sodium chloride, dissolved gases, minerals, and nutrients. These components determine and direct the interactions between the seawater and its inhabitants. The most important physical and chemical properties are salinity, pH, density, dissolved gases, and temperature. Water quality in the open ocean is excellent, with high water clarity, low concentration of suspended matter, dissolved oxygen concentrations at or near saturation, and low concentrations of contaminants such as trace metals and hydrocarbons (PMRF, 1998).

Biological Diversity

Although oceans have far fewer species of plants and animals than terrestrial and freshwater environments, an incredible variety of living things reside in the ocean. Marine life ranges from microscopic one-celled organisms to the world's largest animal, the blue whale. Marine plants and plant-like organisms can live only in the sunlit surface waters of the ocean, the photic zone, which extends to only about 330 ft (101 m) below the surface. Beyond the photic zone, the light is insufficient to support plants and plant-like organisms. Animals, however, live throughout the ocean from the surface to the greatest depths.

The depth of the ocean area within much of the ROI is well over 12,000 ft (3,660 m). Within the ROI, marine biological communities can be divided into two broad categories: pelagic and benthic. Pelagic communities live in the water column and have little or no association with the bottom, while benthic communities live within or upon, or are otherwise associated with, the bottom.

The organisms living in pelagic communities may be drifters (plankton) or swimmers (nekton). The plankton includes larvae of benthic species, so a pelagic species in one ecosystem may be a benthic species in another. The plankton consists of plant-like organisms (phytoplankton) and animals (zooplankton) that drift with the ocean currents, with little ability to move through the water on their own. The nekton consists of animals that can swim freely in the ocean, such as fish, squids, sea turtles, and marine mammals. Benthic communities are made up of marine organisms that live on or near the sea floor, such as bottom dwelling fish, shrimps, worms, snails, and starfish.

Threatened and Endangered Species

The over-ocean launch corridor ROI contains a number of threatened, endangered, and other protected species, including various cetacean species (whales, dolphins, and porpoises), sea turtles, pinnipeds, and sea otters. These are listed in Table 3-4, which indicates their status and months present, along with their preference for ocean depth. Many of these species can be found near the range areas proposed for conducting MM III launches and RV tests, but their occurrence near the range areas may be seasonal, in some cases, because of their unique migration patterns. Some species, particularly the larger cetaceans, can occur hundreds or thousands of miles off coastal areas.

Noise in the Ocean Environment

In the marine environment, there are many different sources of noise, both natural and anthropogenic. Although no noise measurements are known to exist for the ROI, it is expected that the loudest surface noise originates from lightning storms. Thunder, which can produce 110- to 120-dB peak sound pressure levels, can occur repeatedly as a storm passes over.

Table 3-4. Protected Marine Mammal and Sea Turtle Species Occurring in the Over-Ocean Launch Corridor

Common Name	Scientific Name	Status	Months Present[1]	Depth Preference		
				<200 (m)	200 – 2,000 (m)	> 2000 (m)
Pinnipeds						
Northern fur seal	*Callorhinus ursinus*	MMPA	May – Nov			X
Guadalupe fur seal	*Arctocephalus townsendi*	T, St	-	X	X	X
California sea lion	*Zalophus californianus*	MMPA	All	X	X	X
Harbor Seal [2]	*Phoca vitulina richardsi*	MMPA	All [3]	X	X	
Elephant seal	*Mirounga angustirostris*	MMPA	All	X	X	X
Steller sea lion[2]	*Eumetopias jubatus*	T, St	-	X	X	-
Sea Otters						
Southern sea otter	*Enhydra lutris nereis*	T, St	Apr – May Jul – Aug	X		
Small Cetaceans						
Harbor porpoise	*Phocoena phocoena*	MMPA	All	X		
Dall's porpoise	*Phocoenoides dalli*	MMPA	All	X	X	
Bottlenose dolphin	*Tursiops truncatus*	MMPA	All	X	X	X
Common dolphin	*Delphinus delphis*	MMPA	All	X	X	X
Striped dolphin	*Stenella coeruleoalba*	MMPA	All			X
Northern right whale dolphin	*Lissodelphis borealis*	MMPA	All		X	X
Risso's dolphin	*Grampus griseus*	MMPA	All		X	X
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	MMPA	All	X	X	X
Pantropical spotted dolphin	*Stenella attenuata*	MMPA	All	X	X	
Short-finned pilot whale	*Globicephala macrorhynchus*	St	All		X	X
Killer whale	*Orcinus orca*	MMPA	All	X	X	
False killer whale	*Pseudorca crassidens*	MMPA	All		X	X
Beaked Whales						
Cuvier's beaked whale	*Ziphius cavirostris*	MMPA	All		X	X
Large Odontocetes (Toothed Whales) and Mysticetes (Baleen Whales)						
Sperm whale	*Physeter catodon*	E, St	All		X	X
Gray whale	*Eschrichtius robustus*	MMPA	Nov – Dec Apr – May [4]	X		
Humpback whale	*Megaptera novaeangliae*	E, St	Feb - Oct	X	X	
Right whale	*Balaena glacialis*	E, St	-	X	X	X
Sei whale	*Balaenoptera borealis*	E, St	July – Sept		X	X
Blue whale	*Balaenoptera musculus*	E, St	June – Nov	X	X	X
Finback whale	*Balaenoptera physalus*	E, St	All		X	X
Bryde's whale	*Balaenoptera edeni*	MMPA	All		X	X
Minke whale	*Balaenoptera acutorostrata*	MMPA	All	X	X	X
Sea Turtles						
Green sea turtle	*Chelonia mydas*	T	-			
Hawksbill sea turtle	*Eretmochelys imbricata*	E	-			
Loggerhead sea turtle	*Caretta caretta*	T	-			
Olive ridley sea turtle	*Lepidochelys oliveacea*	T	-			
Leatherback sea turtle	*Dermochelys coriacea*	E	-			

Notes:
MMPA = Protected under the Marine Mammal Protection Act
St = Strategic stock under the MMPA (average human-caused mortality may not be sustainable)
E = Endangered (also depleted under the MMPA)
T = Threatened (also depleted under the MMPA)

[1]For ocean water off the California coast
[2]Currently being considered for Endangered status
[3]Breeds on VAFB late Feb through April; pups born in March and early April. Period from 1 Feb to 31 May considered sensitive.
[4]Cows with calves present offshore of VAFB February - May

While measurements for sound pressure levels in air are referenced to 20 μPa, underwater sound levels are normalized to 1 μPa at 3.3 ft (1 m) away from the source, a standard used in underwater sound measurement. Within the ROI, some of the loudest underwater sounds are most likely to originate from ships and some marine mammals. A humpback whale (*Megaptera novaeangliae*), for example, can produce moaning sounds up to 175 dB (referenced to 1 μPa); while dolphins are known to produce brief echolocation signals over 225 dB (referenced to 1 μPa). Motors from a passing supertanker may generate 187 dB (referenced to 1 μPa) of low frequency sound. (Boyd, 1996; Nachtigall, et al., 2003)

3.5 US ARMY KWAJALEIN ATOLL

The USAKA is located in the RMI, approximately 2,000 nautical miles (3,706 km) southwest of Hawaii (see Figure 2-10). It consists of all or portions of 11 of the 100 coral islands that enclose a large lagoon. Since the late 1950's, the Kwajalein Atoll has served as a primary site for testing ICBMs, sea-launched ballistic missiles, and antiballistic missiles. Today, USAKA is home to the RTS, which continues to support these and other DOD programs.

Because of international agreements between the RMI and the United States, all activities at USAKA must conform to specific compliance requirements, coordination procedures, and environmental standards identified in the UES.

The baseline conditions described in this section are based on information contained in the UES, various surveys conducted at USAKA, and the *Final Supplemental Environmental Impact Statement for Proposed Actions at US Army Kwajalein Atoll* (USASSDC, 1993). This EIS provided a detailed analysis of ongoing and future operations in support of antiballistic missile defense tests and other defense testing. It also identifies the use of Kwajalein Atoll as a target area for ICBM FDE types of tests. As appropriate, other sources of information used to develop this section are also referenced.

Rationale for Environmental Resources Analyzed

For the proposed MM III flight test activities at USAKA, biological resources, cultural resources, health and safety, and hazardous materials and waste management (including pollution prevention) are the only areas of concern requiring discussion. Noise and water quality were also included in the analysis, from the standpoint of potential impacts on vegetation and wildlife. As for other resource areas not analyzed further, the proposed flight test activities would not require any new construction or extensive ground-disturbing activities; therefore, no impacts to soils would be expected. Mostly existing base personnel would be involved; thus, there are no socioeconomic concerns. Since impacts would be confined to the vicinity of Illeginni Island (an uninhabited island), open water areas in the Mid-Atoll Corridor Impact Area, and/or open ocean areas off Kwajalein Atoll, there would be no impacts to the human noise environment. The proposed activity is well within the limits of current operations at USAKA. As a result, there would be no adverse effects on land use, utilities, solid waste management, or transportation; and little or no additional impacts to air quality, or airspace use.

3.5.1 Biological Resources

For purposes of analyzing biological resources at USAKA, the ROI includes the missile impact area, consisting of the Mid-Atoll Corridor, the broad open ocean area offshore of Kwajalein Atoll, and Illeginni Island (see Figure 2-12).

The Mid-Atoll Corridor straddles Kwajalein Atoll, which is a crescent-shaped coral reef dotted with a string of approximately 100 islands that enclose the world's largest lagoon [1,100 square mi (2,849 square km)]. Lagoon depths are typically 120 to 180 ft (37 to 55 m), although numerous coral heads approach or break the surface. Ocean depths outside the lagoon descend rapidly, to depths as much as 13,000 ft (3,952 m) within 5 mi (8 km) of the atoll. The top of the Kwajalein Atoll reef (or reef flat) is intertidal. Natural passages through the reef flat allow passage of marine mammals, sea turtles, and other marine life to and from the lagoon.

Both the reef rock from which the atoll is built, and the sands and sediments of its beaches and lagoon bottom, are formed entirely from the remains of calcium-secreting marine organisms such as coral, coralline algae, calcareous algae, mollusks, and foraminiferans. The tops of the reefs are a thin veneer of actively growing organisms that accrete over the remains of prior generations of reef organisms and add to the reef structure. The reef-building organisms are sensitive to sedimentation, burial, and changes in circulation caused by human activities.

The descriptions of biological resources provided in the paragraphs that follow are based largely on past surveys conducted by the USFWS and NMFS. In accordance with requirements specified in the UES, USAKA must conduct a natural resource baseline survey every 2 years to identify and inventory protected or significant fish, wildlife, and habitat resources at USAKA (USASMDC, 2003a). In providing support to USAKA, USFWS and NMFS personnel normally conduct the biennial biological resource inventories at all islands leased from the RMI, which includes those areas on and adjacent to Illeginni Island. These surveys were initiated in 1996 and continue to be conducted on a regular basis every 2 years. The last survey was conducted in Fall 2004; however, the 2004 survey report will not be available until sometime in 2005 at the earliest. It is important to note that the USAKA survey data is qualitative in nature, so data gathered at other geographical locations [i.e., Pacific Missile Range Facility (PMRF), Hawaii], with known species densities, were used to determine risks to marine mammals in Chapter 4.0. Although the population sizes of marine mammals in the vicinity of Illeginni are not known, the surrogate data used in the analysis is considered to be conservative since marine mammal densities at Kwajalein Atoll are not expected to exceed densities in areas of Hawaii, where marine mammals have been documented for many years. For sea turtles, however, no comparable data existed, so the probability for habitat destruction was evaluated since the habitat details are known.

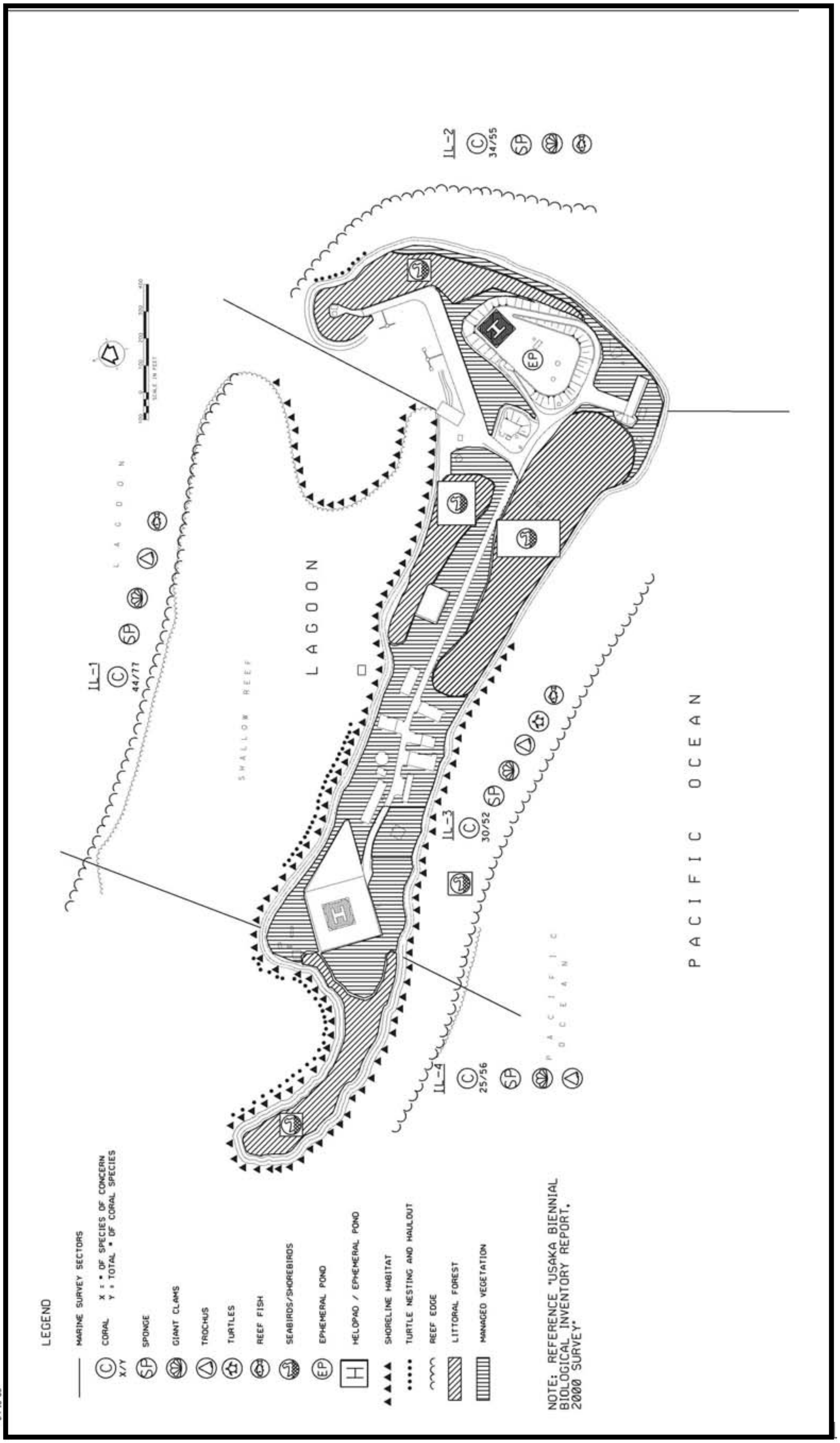
Vegetation

Illeginni is a 31-acre (12.5-hectare) island consisting of managed vegetation (primarily grassy lawns) surrounding buildings and other facilities, and four relatively large patches of native vegetation (see Figure 3-3). The native vegetation present on the island consists of one patch of herbaceous strand and several patches of littoral (near shore) forest. The forest areas are made up primarily of *Pisonia*, *Intsia*, *Tournefortia*, and *Guettarda* trees. Some littoral shrubland can also be found mostly on the western end of the island. (USFWS/NMFS, 2002)

Threatened, Endangered, and Other Protected Species

Within the area of Kwajalein Atoll, the UES provides protection for all of the following:

- Any threatened or endangered species that may be present
- Any species proposed for designation, candidates for designation, or petitioned for designation to the endangered species list that could be affected by USAKA activities
- All species designated by the RMI under applicable RMI statutes, such as the RMI Endangered Species Act of 1975, Marine Mammal Protection Act of 1990, Marine Resources (Trochus) Act of 1983, and the Marine Resources Authority Act of 1989



Source: Modified from USASMDC, 2003a

Figure 3-3. Wildlife Habitats at Illeginni Island

- Marine mammals designated under the US Marine Mammal Protection Act of 1972 that may be affected by USAKA activities

- Bird species pursuant to the Migratory Bird Conservation Act that are potentially present in the RMI

- Species in the RMI that are protected by the Convention on International Trade in Endangered Species, or mutually agreed on by USAKA, USFWS, NMFS, and the RMI Government as being designated as protected species. (USASMDC, 2003a)

The Kwajalein Atoll lagoon, reefs, and surrounding ocean waters are home to a number of threatened, endangered, and other protected species. As shown in Table 3-5, endangered marine mammals that may occur in and around Kwajalein Atoll include some of the same baleen and toothed whales found off the Hawaiian Islands [e.g., the blue whale (*Balaenoptera musculus*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and sperm whale (*Physeter catodon*)]. These are open-water, widely distributed species and are not likely to be found in the lagoon area. Near Illeginni, a group of up to 12 sperm whales has been seen consistently to the west of the island, on the ocean side, several hundred yards offshore. Because calves have been seen with females, the group could represent a "nursery pod" of related females and their young. Further verification of this is needed. (Naughton, 2003; USFWS/NMFS, 2002)

Table 3-5. Threatened, Endangered, and Other Protected Species Occurring at US Army Kwajalein Atoll

Common Name	Scientific Name	Status
Marine Mammals		
Dugong	*Dugong dugon*	E
Blue Whale	*Balaenoptera musculus*	E
Finback Whale	*Balaenoptera physalus*	E
Humpback Whale	*Megaptera novaengliae*	E
Sperm Whale	*Physeter catodon*	E
Offshore Spotted Dolphin	*Stenella attenuata attenuata*	RS
Coastal Spotted Dolphin	*Stenella attenuata graffmani*	RS
Eastern Spinner Dolphin	*Stenella longirostris orientalis*	RS
Whitebelly Spinner Dolphin	*Stenella longirostris longirostris*	RS
Costa Rican Spinner Dolphin	*Stenella longirostris centroamericana*	RS
Common Dolphin	*Delphinus delphis*	RS
Striped Dolphin	*Stenella coeruleoalba*	RS
Spinner Dolphin	*Stenella longirostris*	MMPA
Pacific Bottlenose Dolphin	*Tursiops gilli*	MMPA
Risso's Dolphin	*Grampus griseus*	MMPA
Bottlenose Dolphin	*Tursiops sp.*	MMPA
Pygmy Sperm Whale	*Kogia breviceps*	MMPA
False Killer Whale	*Pseudorca crassidens*	MMPA
Short-Finned Pilot Whale	*Globicephala macrorhynchus*	MMPA
Melon Headed Whale	*Peponocephala electra*	MMPA
Pygmy Killer Whale	*Feresa attenuata*	MMPA

Table 3-5. Threatened, Endangered, and Other Protected Species Occurring at US Army Kwajalein Atoll

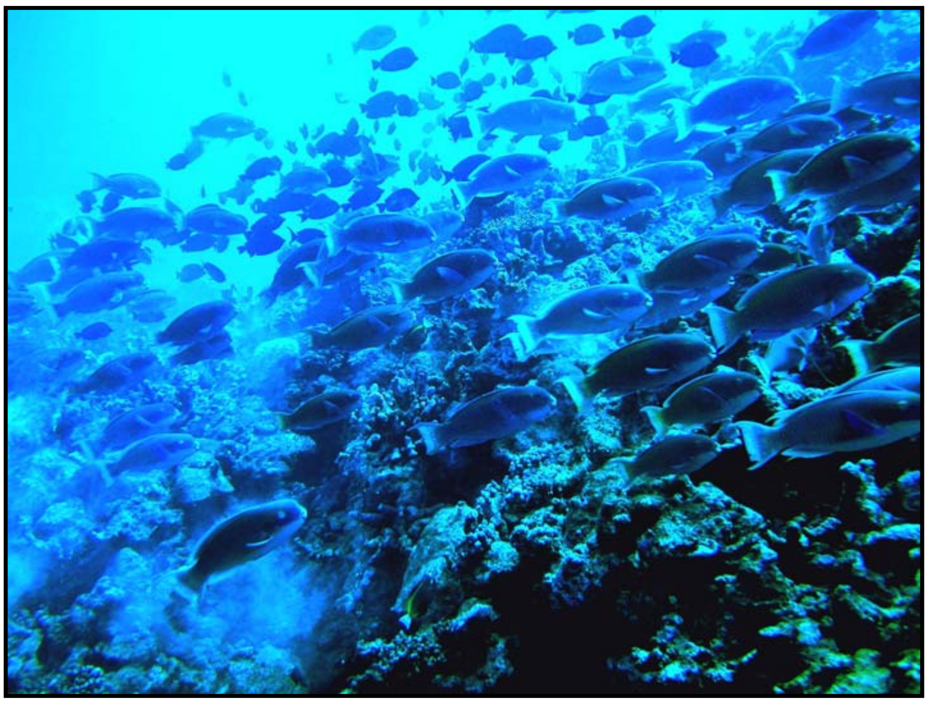
Common Name	Scientific Name	Status
Killer Whale	*Orcinus orca*	MMPA
Blainville's Beaked Whale	*Mesoplodon densirostris*	MMPA
Sea Turtles		
Green Sea Turtle	*Chelonia mydas*	T
Loggerhead Sea Turtle	*Caretta caretta*	T
Olive Ridley Sea Turtle	*Lapidochelys olivacea*	T
Leatherback Sea Turtle	*Dermochelys coriacea*	E
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E
Mollusks Observed at Illeginni Island		
Top-Snail Shell	*Trochus niloticus*	RS
Giant Clam	*Tridacna maxima*	CITES
Giant Clam	*Tridacna gigas*	CITES
Giant Clam	*Tridacna squamosa*	CITES
Giant Clam	*Hippopus hippopus*	CITES
Sponges Observed at Illeginni Island		
Various sponge species identified in Table 13 of the Year 2000 Species Inventory for USAKA (USFWS/NMFS, 2002)		RS
Coral Species Observed at Illeginni Island		
Various coral species identified in Table 12(g) of the Year 2000 Species Inventory for USAKA (USFWS/NMFS, 2002)		CITES
Migratory Birds Observed at Illeginni Island		
Pacific Reef Heron	*Egretta sacra*	MBCA
Pacific Golden Plover	*Pluvialis fulva*	MBCA
Wandering Tattler	*Heteroscelus incanus*	MBCA
Tattler species	*Heteroscelus sp.*	MBCA
Whimbrel	*Numenius phaeopus*	MBCA
Bristle-Thighed Curlew	*Numenius tahitiensis*	MBCA
Godwit species	*Limosa sp.*	MBCA
Ruddy Turnstone	*Arenaria interpres*	MBCA
Brown Booby	*Sula leucogaster*	MBCA
Black-Naped Tern	*Sterna sumatrana*	MBCA
Brown Noddy	*Anous stolidus*	MBCA
Black Noddy	*Anous minutus*	MBCA
White Tern	*Gygis alba*	MBCA
Great Crested Tern	*Sterna bergii*	MBCA

Notes:
E = Endangered
T = Threatened
RS = Protected under RMI Statute
MMPA = Protected under the Marine Mammal Protection Act
CITES = Protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora
MBCA = Protected under the Migratory Bird Conservation Act

Source: USASMDC, 2003a; USFWS/NMFS, 2002

Also listed in Table 3-5, several threatened and endangered species of sea turtles can be found in the lagoon and ocean waters surrounding USAKA. These include the hawksbill sea turtle (*Eretmochelys imbricata*) and green sea turtle (*Chelonia mydas*). A hawksbill sea turtle was observed in the lagoon just north of Illeginni Island in 2002, while an adult green sea turtle was seen on the seaward side of the island in 1996 (Foster, 2004; USFWS/NMFS, 2000).

The marine environment surrounding Illeginni supports a community of corals, fish, and invertebrates including the following protected species: mollusks, such as giant clams (including *Tridacna maxima* and *Hippopus hippopus*) and top-snail shell (*Trochus niloticus*); close to 20 species of sponges (includes the genera *Adocia*, *Chelonaplysilla*, *Druinella*, *Ianthella*, *Pericharax*, and *Stylinos*); and over 75 species of coral (includes the genera *Acropora*, *Favia*, *Fungia*, *Millepora*, *Pavona*, and *Pocillopora*) (USFWS/NMFS, 2002). Figure 3-3 shows areas where various protected species can be found at Illeginni Island. A small sample of the coral cover and fish populations along the reef can be seen in the following photograph (Figure 3-4), taken from the ocean side of Illeginni.



Source: Naughton, 2004

Figure 3-4. Underwater View of the Reef Environment at Illeginni Island

On Illeginni, a number of protected migratory seabirds and shorebirds have been seen either breeding, roosting, or foraging on the island. They include the black-naped tern (*Sterna sumatrana*), brown noddy (*Anous stolidus*), black noddy (*Anous minutus*), white tern (*Gygis alba*), pacific golden plover (*Pluvialis fulva*), wandering tattler (*Heteroscelus incanus*), whimbrel (*Numenius phaeopus*), bristle-thighed curlew (*Numenius tahitiensis*), and the ruddy turnstone (*Arenaria interpres*). (USFWS/NMFS, 2002)

Other Species

Within the waters surrounding Illeginni, various non-listed species of coral, mollusks, and other invertebrates (e.g., sea stars, sea urchins, and crinoids) can also be found. Some of the reef fish species observed in the area include surgeonfishes (*Acanthurus olivaceus*), snappers (*Lutjanus bohar* and *L. gibbus*), groupers (*Plectropomus areolatus* and *Anyperodon leucogrammicus*), grey reef sharks (*Carcharhinus amblyrhynchos*), and parrotfishes (*Scarus rubroviolaceus*). (USFWS/NMFS, 2002)

Terrestrial species observed on Illeginni include rats and three species of ants (USFWS/NMFS, 2002). These non-native species were accidentally introduced to the island some years earlier.

Environmentally Sensitive and Critical Habitat

No designated essential fish habitat is identified for the Marshall Islands. However, 250 species of reef fish are located in the atolls of the Marshall Islands. Because food cultivation on the islands is limited, fish and other sea life are of important dietary value to the Marshallese people (Pacific Island Travel, 2002). In an effort to protect the fisheries, the multilateral fisheries agreement between the United States and South Pacific island governments, including the Marshall Islands, have adopted a treaty (United Nations Agreement on Highly Migratory Fish Stocks and Straddling Fish Stocks) that promotes the long-term sustainable use of highly migratory species, such as tuna, by balancing the interests of coastal states and states whose vessels fish on the high seas. (US Department of State, 2002)

Illeginni Island has marine and terrestrial habitats of significant biological importance, as defined in the UES and shown in Figure 3-3. The terrestrial habitats of significant importance include the mixed broadleaf (littoral) forest, seabird colonies, and the shorebird sites around the island. Sea turtle nesting and haul-out areas have been identified along some shorelines. The marine habitats considered biologically important are the lagoon-facing reef slope and reef flat, the inter-island reef flat, the lagoon floor, the ocean-facing reef slope and reef flat, the intertidal zone, and the reef pass. All of these habitats are considered important because of the presence or possible presence of protected species. (USASMDC, 2003a; USFWS/NMFS, 2002)

Based on prior surveys conducted around the island, coral cover is moderate to high in most areas. Mollusks are abundant in the lagoon north of the island, while marine life in general is abundant and diverse on the ocean side south of the island. Towards the southwestern side of the island, the water column was previously shown to be moderately turbid. Further west and south of the helipad, there is a marked degradation of the coral cover. During surveys conducted in 2000, coral mortality in this area was observed to an approximate depth of 82 ft (25 m). Live coral cover appeared to be low, and the benthic substrate was dominated by rubble. (USFWS/NMFS, 2002)

Island surveys have shown shorebirds to use the managed vegetation throughout the island's interior. Pooled water on the helipad attracts both wintering shorebirds and some seabirds. White terns have been observed in trees at the northwest corner and southwest quadrant of the island. The shoreline embankment and exposed inner reef provides a roosting habitat for great crested terns and black-naped terns. Seabirds have been seen concentrated in the island's southeast quadrant where the littoral forest supports the second-largest nesting colony of black noddies in the USAKA islands; nearly 150 nests were identified in 2000. There are also signs of black-naped tern nesting on the western tip of the island. (USFWS/NMFS, 2002)

As shown in Figure 3-3, suitable sea turtle haul-out/nesting habitat exists along the shoreline northwest and east of the helipad on the lagoon side of Illeginni (USFWS/NMFS, 2002). During surveys conducted in 1996, sea turtle nest pits were observed near the western end of the island (USFWS/NMFS, 2000).

3.5.2 Cultural Resources

Buildings and other facilities at Illeginni are situated primarily in the central and eastern portions of the island (see Figure 3-3). Most of them are no longer used and have been abandoned in place. Previous investigations identified almost all of the buildings as having potential eligibility for nomination to the US NRHP because of their Cold War-era historic importance (USASSDC/TBE, 1996). However, with implementation of the 2001 Historic Preservation Plan for USAKA, NRHP eligibility is no longer the standard for assessing historic structures at USAKA (USASMDC, 2001).

The buildings determined to be potentially eligible for the US NRHP have since been examined to determine their eligibility for listing in the RMI List of Cultural and Historic Properties. None of the sites on Illeginni meet any of the 11 criteria listed in RMI Land Modification Regulations (Part III, Section 5, Criteria for Recognition as a Cultural and Historic Property) (RMI, 1991). Further classification of site significance, under Section 6 of the same regulation, found that all of the sites qualify as “insignificant” under subsection (d)(iv) because: (1) the resource is abundant on the atoll concerned; (2) it does not form part of an ensemble of sites or features; and (3) sufficient, well-preserved examples of the resource remain intact.

Some studies have identified the possibility of buried traditional or prehistoric remains on Illeginni (Carucci, 1997; USASSDC, 1996). In all probability, any remains that might have survived the construction of the remote launch site on the east side of the island, and subsequent use of the island as an RV impact site, are buried under significant amounts of modern fill. Limited subsurface testing on the island found that disturbance to the original land surface was severe, especially along the lagoon-facing shoreline; most of which had been bulldozed (Craib, et al., 1989). Although some stands of vegetation exist, they are relatively young. No indigenous cultural materials or evidence of subsurface deposits have been found (Craib, et al., 1989). Midden-associated charcoal that was noted along the lagoon shoreline (USASSDC, 1996) is most likely a modern intrusion (USASMDC, 1997).

3.5.3 Health and Safety

Since USAKA will be used during flight tests only as the target area, no health and safety issues related to launch safety, launch hazards, or fuels handling apply. The relevant issue is post-boost vehicle and RV impact area safety.

The ROI for health and safety at USAKA includes all areas where the RVs impact in the Mid-Atoll Corridor, and the ocean waters near USAKA—the same general area now used for ICBM FDE flights. This includes the hazard area outside the atoll, where post-boost vehicle fragments sometimes impact.

USAKA has the unique mission of serving as the target for a wide variety of missile launch operations from Vandenberg AFB, California, and the Pacific Missile Range Facility in Hawaii. These missions are conducted with the approval of the USAKA Commander. A specific procedure is established to ensure that such approval is granted only when the safety requirements for proposed test activities have been adequately addressed.

All program operations must receive the approval of the USAKA Safety Directorate. This is accomplished through presentation of the proposed program to the Safety Directorate. All safety analyses, standard operating procedures, and other safety documentation applicable to those operations affecting the USAKA must be provided, along with an overview of mission objectives, support requirements, and schedule. The Safety Directorate evaluates this information and ensures that all USAKA safety requirements specified in the UES, and supporting regulations, are followed. (USASSDC, 1995)

Prior to operations that may involve missile impacts within the range, an evaluation is made to ensure that populated areas, critical range assets, and civilian property susceptible to damage are outside predicted impact limits (i.e., the hazard area). A NOTMAR and a NOTAM are published and circulated in accordance with established procedures to provide warning to personnel, including residents of the Marshall Islands, concerning any potential hazard area that should be avoided. Radar and visual sweeps of hazard areas are accomplished immediately prior to operations to assist in the clearance of non-critical personnel. Only mission-essential personnel are permitted in hazard areas. (USASSDC, 1995)

In operations that involve the potential for RV debris near inhabited islands, precautions are taken to protect personnel. In hazard areas, where an island has an unacceptably high probability of impact by debris, personnel are evacuated. In caution areas, where the chance of debris impact is low, precautions may consist of evacuating nonessential personnel and sheltering remaining inhabitants. Sheltering is required for RV missions impacting the Mid-Atoll Corridor at USAKA. The Mid-Atoll Corridor is declared a caution area when it contains a point of impact. Remaining inhabitants of Kwajalein Atoll islands in this corridor are required to seek shelter. (USASSDC, 1993)

Prior to flight operations, proposed trajectories are analyzed and a permissible flight corridor is established. A flight that strays outside its corridor is considered to be malfunctioning and to constitute an imminent safety hazard. A destruct package, installed in all flight vehicles capable of impacting inhabited areas, is then activated. Activating the destruct package effectively halts the continued powered flight of the hardware, which falls to the ocean along a ballistic trajectory. (USASSDC, 1995)

3.5.4 Hazardous Materials and Waste Management

As a requirement of the UES, the Army has prepared the *Kwajalein Environmental Emergency Plan* (KEEP) for responding to releases of oil, hazardous material, pollutants, and other contaminants into the environment (USAKA/RTS, 2003). The KEEP is substantively similar to the spill prevention, control, and countermeasure plan often required in the United States. As part of the KEEP, a *Hazardous Materials Management Plan* (HMMP) has been prepared to address USAKA's import, use, handling, and disposal of hazardous materials. This Plan includes maintaining an inventory of hazardous materials routinely imported and used at USAKA. As part of pollution prevention, recycling, and waste minimization activities, each revision of the HMMP includes both a description of the steps taken to reduce the volume and toxicity of the generated waste, and a description of the changes in volume and toxicity of waste achieved since the last revision.

Commonly used hazardous materials (e.g., cleaning solvents, paints, and petroleum products) are managed and distributed through the base supply system. Tenants, construction contractors, program offices, and other recipients importing activity-specific hazardous materials into USAKA are required to submit— within 15 days of receiving the material or before actual use, whichever comes first—a separate Hazardous Materials Procedure to the Commander, USAKA, for approval. Such procedures outline requirements for material storage, use, transportation, and eventual disposal.

Hazardous or toxic waste treatment or disposal is not allowed at USAKA under the UES. Hazardous waste, whether generated by USAKA activities or by range users, is handled in accordance with the procedures specified in the UES. Hazardous wastes are collected at individual work sites in waste containers. Containers are kept at the point of generation accumulation site until they are full, or until a specified time limit is reached. Containers are then collected from the generation point and transported to the USAKA Hazardous Waste 90-Day Storage Facility on Kwajalein Island. Wastes are then shipped off-island by barge for treatment and disposal in the continental United States.

Training programs play an integral and active part in the USAKA environmental management program to ensure that the installation complies with all environmental requirements. The installation contractor continually updates training programs so employees are fully aware of procedures and policies associated with the following topics:

- Hazardous waste management/reduction
- Methods of testing and ensuring proper operation of equipment
- Hazardous materials handling
- Spill prevention, control, and response
- Countermeasures to contain, clean up, and mitigate the effects of a spill or discharge.

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4.0 ENVIRONMENTAL CONSEQUENCES

This chapter presents the potential environmental consequences of the No Action Alternative and the Proposed Action, described in Chapter 2.0 of this EA, when compared to the affected environment described in Chapter 3.0. The amount of detail presented in each section of the analysis is proportional to the potential for impact. Because environmental issues associated with the proposed MM III modification vary widely, not all of the same resources are analyzed for each location or for all activities. For example, the proposed test and/or deployment activities for RS modifications affect all sites and all resources analyzed; however, the replacement of command and control console equipment affects only hazardous materials and waste management at the five AFBs. A breakdown of the resources analyzed in detail, by location, is shown in Table 4-1, along with the section numbers where the respective No Action Alternative and Proposed Action discussions can be found.

Table 4-1. Resources Analyzed in Detail by Location

Location	Air Quality	Noise	Biological Resources*	Cultural Resources	Health & Safety	Hazardous Materials & Waste Management
FE Warren, Malmstrom, & Minot AFBs					Sect. 4.1.1	Sect. 4.1.2
Hill AFB					Sect. 4.2.1	Sect. 4.2.2
Vandenberg AFB	Sect. 4.3.1	Sect. 4.3.2	Sect. 4.3.3		Sect. 4.3.4	Sect. 4.3.5
Over-Ocean Launch Corridor			Sect. 4.4.1			
US Army Kwajalein Atoll			Sect. 4.5.1	Sect. 4.5.2	Sect. 4.5.3	Sect. 4.5.4

*Noise and water quality are included in the analysis, from the standpoint of potential impacts on vegetation and wildlife.

In the discussions that follow, both *direct* and *indirect* impacts[4] are addressed where applicable. In addition, any *cumulative* effects that might occur are identified later in Section 4.6. Appropriate mitigation measures are also identified, where necessary, and summarized in Section 4.7. A list of all agencies and other personnel consulted, as part of this analysis, is included in Chapter 7.0.

4.1 FE WARREN, MALMSTROM, AND MINOT AIR FORCE BASES

The following sections describe the potential environmental consequences of the No Action Alternative and the implementation of the Proposed Action at FE Warren AFB, WY; Malmstrom AFB, MT; and Minot AFB, ND.

4.1.1 Health and Safety

4.1.1.1 No Action Alternative

[4] *Direct* impacts are caused by the action and occur at the same time and place. *Indirect* impacts occur later in time or are farther removed in distance, but are still reasonably foreseeable.

Missile System Maintenance

Removal of the RS, the solid propellant booster, or the entire MM III missile from remote LFs—followed by their transportation back to the main base, maintenance, system checks, parts replacement, occasional system upgrades, and booster motor change-outs—are all routine activities at all three Wings. All applicable Federal, state, and local health and safety requirements, such as Occupational Safety and Health Administration (OSHA) regulations within 29 CFR, are followed, as well as all appropriate DOD and USAF regulations. The handling of large rocket motors and other missile ordnance is a hazardous operation that requires special care and training of personnel. By adhering to the established and proven safety standards and procedures identified in Section 3.1.1, the level of risk to military personnel, contractors, and the general public would be minimal.

Between the LFs and each Wing support base, the RS containing operational RVs is transported in a specialized payload transporter, while the booster motor is transported in a TE, both of which provide environmental protection and physical security of the missile components. When the boosters are used for flight tests at Vandenberg AFB (normally three or four per year), or require other maintenance work at Hill AFB, they are transferred to a heavily constructed MT trailer for the long haul over public roads and highways. All transportation and handling requirements for the RS, the booster, and other ordnance would be accomplished in accordance with DOD, USAF, and DOT policies and regulations to safeguard the materials from fire or other mishap. As previously described in Section 3.1.1, accident rates for ongoing operations involving missile rocket motor transportation have historically been very low.

Consequently, no significant impacts to health and safety are expected.

4.1.1.2 Proposed Action

Under the proposed action, the number of boosters needed for flight tests at Vandenberg AFB would increase by only four in the FY 2005 and 2006 timeframe. Handling and transportation requirements for MM III boosters and other missile components would be conducted in the same manner as for the No Action Alternative, in accordance with Federal, state, local, DOD, USAF, and DOT regulations. Transportation requirements for the additional boosters would have virtually no effect on the frequency of vehicular accidents on public roads and highways.

The reconfiguration of the MM IIIs to carry the newer Mark 21 RV and warhead—requiring hardware and software modifications to the RS, and other support equipment—would be conducted during normal ongoing maintenance operations. The hardware components and software installation would not present a health hazard when systems are removed, installed, maintained, or in storage. The hardware and software components would be constructed and packaged to eliminate or minimize safety risks to an acceptable level for operators, maintainers, and support personnel. The system components would be marked with appropriate warnings and cautions to prevent injury to the operators and maintainers. All facilities involved would comply with OSHA, DOD, and DOT health and safety standards.

Consequently, no significant impacts to health and safety are expected.

4.1.2 Hazardous Materials and Waste Management

4.1.2.1 No Action Alternative

Missile System Maintenance

The removal of MM IIIs from remote LFs, transportation to the support base, maintenance, system checks, parts replacement, occasional system upgrades, and booster motor change-outs are all routine activities at the three Wings. During this process, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.2. All hazardous and non-hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

Console Equipment Maintenance

The replacement of aging or failed console equipment at the LCCs in the Wing areas would not involve the direct handling of hazardous materials or wastes, since any materials in the units are sealed inside. However, failed HDA and VDU units that cannot be repaired would be declassified and turned over to the Defense Reutilization and Marketing Service (DRMS), which manages excess and surplus DOD property, including electronics.

Electronic products can contain a variety of toxic constituents. Computer monitors with cathode ray tubes, printed wiring boards, and other electronic components often contain hazardous constituents such as lead, phosphorus, and cadmium. DRMS manages the disposal of equipment and other military property containing hazardous material and/or waste, which is handled according to the same priorities as other property: (1) reutilization within DOD, (2) transfer to other Federal agencies, (3) donations to qualified state and nonprofit organizations, and (4) sale to the public, including recyclers. This process maximizes the use of each item and minimizes the environmental risks and the costs associated with disposal. Such equipment or other property that cannot be reused or sold is disposed of through commercial service contracts that must comply with applicable Federal, state, and local environmental laws and regulations, including the RCRA, which requires “cradle to grave” management of hazardous materials and wastes. Any hazardous components would be stored in Conforming Storage Facilities (CSFs) located at local DRMO complexes. CSFs meet state and Federal requirements, and provide safe, temporary storage during the disposal cycle (DRMS, 2003). As a result, no adverse impacts from the management of hazardous materials and waste are expected.

4.1.2.2 Proposed Action

At each Wing, the reconfiguration of the MM IIIs to carry the newer Mark 21 RV and warhead would require hardware and software modifications to the RS, and other support equipment. The hardware components would come pre-assembled, contained, or packaged in sealed units, and personnel would not handle or become exposed to any hazardous materials they may contain. Little or no hazardous wastes would be generated from the RS modifications and installation of the Mark 21 RVs. Any hardware or software that is faulty would be returned to the manufacturer for repair or recycling in its standard industrial packaging.

As part of the process of modifying the MM III RSs, all of the older Mark 12 RVs would be removed. The long-term storage and/or disposition requirements for the Mark 12 RVs are not part of the proposed MM III modification. Decisions to be made on these actions by the USAF, in cooperation with the DOE, would be supported, as necessary, by additional environmental analyses separate from this EA.

The replacement of MM III command and control console equipment, and related software upgrades, would occur at all operational LCCs in the Wing areas. Upgrading computer software and replacement of

EMAD modules would not involve the handling of hazardous materials—with the possible exception of small amounts of solvent to clean electrical contacts. The old EMAD cards that are removed would be returned to storage as spares and would not go to the DRMOs for disposition.

Deployment of the remaining HDAs and VDUs, occurring as part of routine maintenance or by force deployment, would similarly not involve the handling of hazardous materials—with the possible exception of electrical contact cleaners—since any hazardous materials would be sealed inside the units. The removal and disposal of old console equipment, however, would generate hazardous waste. Each HDA contains trace amounts of cadmium and lead in solder, and each VDU contains approximately 4 lb (1.8 kg) of lead, and trace amounts of cadmium and barium. Table 2-4 identifies the approximate numbers of each item that would be processed at each DRMO location.

Just as under the No Action Alternative, old console equipment would be turned over to the local DRMO, which manages excess and surplus DOD property, including electronics. The proposed disposal of old console equipment would represent approximately 2 to 4 percent of current and ongoing DRMO work at Fort Carson (the location of the DRMO for FE Warren AFB), approximately 5 percent at Malmstrom AFB, and approximately 1 percent at Minot AFB (Ogden ALC, 2003). Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change.

Overall, there should be no adverse impacts on current hazardous materials and waste management operations at any of the Wings or DRMO facilities.

As an alternative for DRMO processing, a few of the HDAs and VDUs could be considered for placement in the USAF Museum Program. Because the equipment would remain intact, there would be no release of hazardous or toxic materials. Thus, no adverse impacts are expected from this particular action.

4.2 HILL AIR FORCE BASE

The following sections describe the potential environmental consequences of the No Action Alternative and the implementation of the Proposed Action at Hill AFB in Utah.

4.2.1 Health and Safety

4.2.1.1 No Action Alternative

Rocket Booster Logistical Support

MM III booster disassembly, reassembly, and maintenance operations are all routine activities at Hill AFB. All applicable Federal, state, and local health and safety requirements, such as OSHA, DOD, and DOT regulations, are followed, as well as all applicable DOD and USAF regulations. By adhering to the established and proven safety standards and procedures identified in Section 3.1.1, the level of risk to military personnel, contractors, and the general public would be minimal. Consequently, no significant impacts to health and safety are expected.

Potential impacts resulting from the transportation of boosters to and from Hill AFB are addressed in Section 4.1.1.1.

4.2.1.2 Proposed Action

In FYs 2005 and 2006, personnel at Hill AFB would assemble two additional MM III replacement boosters per year, in addition to the three or four boosters normally assembled each year because of FDE program launches. These activities would be conducted in the same manner as for the No Action Alternative, in accordance with Federal, state, local, DOD, USAF, and DOT regulations. Consequently, no significant impacts to health and safety are expected.

4.2.2 Hazardous Materials and Waste Management

4.2.2.1 No Action Alternative

Rocket Booster Logistical Support

MM III booster disassembly, reassembly, and maintenance operations are all routine activities at Hill AFB. During these operations, all hazardous materials and associated wastes (i.e., adhesives, sealers, solvents, and contaminated rags) would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.2. All hazardous and non-hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

Console Equipment Maintenance

The replacement of aging or failed MM III command and control console equipment at the SMIC on Hill AFB would not involve the direct handling of hazardous materials, but, as discussed in Section 4.1.2.1, would generate hazardous waste. However, through the local DRMO, equipment and other property containing hazardous materials or wastes are stored in facilities that ensure personnel protection, prevent accidents, and reduce the risk of environmental spills. The DRMS has in place programs for safety and training, storage and inspection, and special handling requirements that minimize risks to workers and the general public (DRMS, 2003). Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. As a result, no adverse impacts from the management of hazardous materials and waste are anticipated.

4.2.2.2 Proposed Action

At Hill AFB, the quantity of hazardous materials used and hazardous wastes generated from the assembly of four additional MM III boosters in the FYs 2005 and 2006 timeframe would be minimal. Moreover, they would be similar to current materials and wastes used and generated from current booster assembly operations, and would not result in any procedural changes in the existing hazardous materials and waste management plans already in place at the base.

The replacement of MM III command and control console equipment, and related software upgrades, would occur at the SMIC on Hill AFB. Just as described for the Minuteman Wings in Section 4.1.2.2, the old EMAD cards would be returned to storage as spares and would not go to the on-site DRMO for disposition. For deployment of the new HDAs and VDUs, removal and disposal of the old units would generate hazardous waste consisting of trace amounts of cadmium and lead solder in each HDA, and approximately 4 lb (1.8 kg) of lead, and trace amounts of cadmium and barium, in each VDU. Table 2-4 identifies the approximate numbers of each console item that would be processed at the local DRMO. The proposed disposal of old console equipment would represent less than 1 percent of current and ongoing DRMO work at Hill AFB (Ogden ALC, 2003).

Overall, there should be no adverse impacts on current hazardous materials and waste management operations on base or at the DRMO facility.

As an alternative for DRMO processing, a few of the HDAs and VDUs could be considered for placement in the USAF Museum Program. However, no adverse impacts are expected from this particular action.

4.3 VANDENBERG AIR FORCE BASE

The following sections describe the potential environmental consequences of the No Action Alternative and the implementation of the Proposed Action at Vandenberg AFB, CA.

4.3.1 Air Quality

4.3.1.1 No Action Alternative

Pre-Flight Preparations

Preparations for the MM III FDE flight tests are conducted in compliance with all applicable SBCAPCD rules and regulations, including those that cover the use of any organic solvents (Rule 317), architectural coatings (Rule 323), or sealants (Rule 353). There are no requirements to add liquid propellants to the PSRE, since it arrives at the base already fueled. Emissions from the limited number of trucks and other vehicles used to support test operations occur intermittently. As a result, there should be no violation of air quality standards or health-based standards of non-criteria pollutants during pre-launch activities.

Flight Activities

Lower Atmospheric Effects. Launch activities for FDE flights must also comply with all applicable SBCAPCD rules and regulations. Under the No Action Alternative, up to four MM III launches per year would continue to occur as part of the current MM FDE flight test program. The total quantity of missile exhaust emissions for four MM III launches is provided in Table 4-2. Only 1st-stage rocket emissions would normally occur within the ROI for Vandenberg AFB.

Table 4-2. Exhaust Emissions for Four Minuteman III Launches

Pollutant	1st Stage (tons/year)	2nd Stage (tons/year)	3rd Stage (tons/year)	Total (tons/year)
CO	0.0101	0.00303	0.00161	0.0147
NO_X	0.448	0.135	0.0715	0.655
PM_{10}[1]	5.03	1.51	0.803	7.34
$PM_{2.5}$[1]	3.52	1.06	0.562	5.14
Hydrogen Chloride	3.93	1.18	0.62	5.73
Other [2]	0.000671	0.000202	0.000107	0.000980

[1] All PM emissions are assumed to be aluminum oxide (Al_2O_3).

[2] Includes combined amounts of polycyclic aromatic hydrocarbons, benzene, formaldehyde, vinyl chloride, antimony, arsenic, cadmium, hexavalent chromium, lead, manganese, and nickel.

Source: HAFB, 2001

During missile flight out over the ocean, rocket emissions from all three stages are rapidly dispersed and diluted over a large geographic area. Because the launches are short-term, discrete events, the time between launches allows the dispersion of the emission products. No violation of air quality standards or health-based standards for non-criteria pollutants would be anticipated.

In the event of an in-flight problem or malfunction that resulted in either intentional or accidental destruction of the MM III missile, the rocket motor casing would be split open, releasing internal pressure and terminating propellant combustion, thus minimizing further emissions.

Upper Atmospheric Effects. The exhaust emissions from the MM III motors contain chlorine compounds, produced primarily as hydrogen chloride at the nozzle. Through high temperature "afterburning" reactions in the exhaust plume, the hydrogen chloride is partially converted to atomic chlorine. These more active forms of chlorine can contribute to localized ozone depletion in the wake of the launch vehicle and to overall global chlorine loading, which contributes to long-term ozone depletion. Studies have shown that the hydrogen chloride remains in the stratosphere for about 3 years and then diffuses down to the troposphere. (Brady, 2002; USAF, 2001a)

Because of the large air volume over which these emissions are spread, and because of rapid dispersion by stratospheric winds, the active chlorine from the MM III flight tests should not contribute to localized depletion of the ozone layer. On a global scale, this represents a very small fraction of chlorine released.

Two other types of substances, aluminum oxide (Al_2O_3) and nitrogen oxide (NO_x) species, also are of concern with respect to stratospheric ozone depletion. The Al_2O_3, which is emitted as solid particles, has been the subject of study with respect to ozone depletion via reactions on solid surfaces. The studies indicate that Al_2O_3 can activate chlorine. The exact magnitude of ozone depletion that can result from a buildup of Al_2O_3 over time has not yet been determined quantitatively, but is considered insignificant based on existing analyses. (USAF, 2001a)

Nitrogen oxide, like certain chlorine-containing compounds, contributes to catalytic gas phase ozone depletion. The production of NO_x species from solid rocket motors is dominated by high-temperature "afterburning" reactions in the exhaust plume. As the temperature of the exhaust decreases with increasing altitude, less NO_x is formed (Brady, 2002). Because diffusion and winds would disperse the NO_x species generated, no significant effect on ozone levels is expected.

In summary, the combined release of hydrogen chloride, Al_2O_3, and NO_x emissions into the stratosphere from up to four MM III launches per year should be insignificant because of the rapid dispersion predicted for such small quantities of substances. Thus, they should not have a significant impact on stratospheric ozone.

Until recent years, the MM III missile used Halon 2402 for the TVC fluid injection on the 2nd stage motor. The Halon gas, a Class I ozone-depleting substance, has since been replaced with perfluorohexane, which is a perfluorocarbon. In some applications, the release of perfluorocarbons would be a cause for concern in terms of added effects to global warming. In this application, however, the perfluorohexane undergoes combustion in the exhaust plume and is not released into the atmosphere. (Dhooge and Nimitz, 2000)

Post-Launch Operations

Post-launch refurbishment activities for FDE test operations will continue to use paints that meet all applicable SBCAPCD rules, including Rule 323 (Architectural Coatings) for volatile organic compounds (VOCs). No air emission permits are required for these operations. With the exception of some minor, localized increases in particulate matter from the occasional brushing of blast residues from the walls and components in and around the launch tube, no adverse effects on air quality are expected.

4.3.1.2 Proposed Action

For purposes of verifying and certifying use of the newly modified RS, two test launches per year would be conducted at Vandenberg AFB in FYs 2005 and 2006, in addition to the current number of MM III FDE missions. Then, beginning in FY 2007, the FDE flights would start using the modified RS. The total number of annual FDE flights, however, would not change. Operations and tests would be conducted in the same manner and in the same facilities as those used for the FDE flights described for the No Action Alternative. Although there would be slight increases in the use of paints (in accordance with all applicable SBCAPCD rules) and vehicular emissions over the FYs 2005 and 2006 period, there would be no violation of air quality standards or health-based standards of non-criteria pollutants during pre-flight preparations or for post-launch operations. Thus, little or no additional impacts on air quality would be expected.

Flight test activities, involving two additional launches per year, would result in a 50 to 67 percent increase in annual MM III emissions over the FYs 2005 and 2006 time period (when compared to the current three to four FDE launches conducted every year). The missile exhaust emission levels for two MM III launches per year are shown in Table 4-3.

Table 4-3. Exhaust Emissions for Two Minuteman III Launches

Pollutant	1st Stage (tons/year)	2nd Stage (tons/year)	3rd Stage (tons/year)	Total (tons/year)
CO	0.00503	0.00151	0.000803	0.00734
NO_X	0.224	0.0674	0.0358	0.327
PM_{10}[1]	2.51	0.757	0.402	3.67
$PM_{2.5}$[1]	1.76	0.53	0.28	2.57
Hydrogen Chloride	1.96	0.591	0.314	2.87
Other [2]	0.000335	0.000101	0.0000536	0.000490

[1] All PM emissions are assumed to be aluminum oxide (Al_2O_3).

[2] Includes combined amounts of polycyclic aromatic hydrocarbons, benzene, formaldehyde, vinyl chloride, antimony, arsenic, cadmium, hexavalent chromium, lead, manganese, and nickel.

Source: HAFB, 2001

Federal conformity rules require that all Federal actions conform to an approved State Implementation Plan or Federal Implementation Plan. Conformity means that an action will not: (1) cause a new violation of the NAAQS, (2) contribute to any frequency or severity of existing NAAQS, or (3) delay the timely attainment of the NAAQS. Conformity applies only to areas that are not in attainment with the Federal standards. Because Santa Barbara County has, until recently, been a nonattainment area for the Federal ozone NAAQS, conformity must be considered for nitrogen oxide (NO_x) and VOC emissions, which are ozone precursors. In accordance with the CAA, a general Conformity Determination is required when total emissions from the Proposed Action exceed 50 tons (45 metric tons) per year of NO_x or VOC, or the Proposed Action results in more than 10 percent of the County emissions inventory.

Conformity applicability analyses previously conducted for target missile launches at Vandenberg AFB—in support of the Ground-Based Midcourse Defense (GMD) Extended Test Range (ETR)—showed all operations to meet *de minimis* requirements and not represent a regionally significant action (USASMDC, 2003b). The GMD ETR analyses assumed up to five launches per year, including MM II and/or Peacekeeper target launch vehicles. These particular launch vehicles are similar in size to (MM II), or larger than (Peacekeeper), the MM III system, and use the same or similar propellants as the MM III booster.

Table 4-3 shows rocket exhaust emissions from the two additional MM III launches, including both NO_x and VOCs (represented by some of the "Other" pollutants). Contributions from Pre-Flight Preparations and Post-Launch Operations (e.g., ground vehicle exhaust emissions) for the two additional launches per year would represent a fraction (~2/5) of the emissions associated with five of the GMD ETR target launch missions. Just as for GMD ETR launch operations, total emissions associated with two additional MM III launches would not exceed the Federal *de minimis* annual limits. In addition, they would not exceed more than 10 percent of the Santa Barbara County emissions identified in Table 3-2. Therefore, further CAA conformity analyses pursuant to 40 CFR Part 51, Subpart W, are not required, and this action does not require a new CAA Conformity Determination. Conformity does not have to be considered for PM_{10} because the area is in attainment with the Federal PM_{10} NAAQS, even though the area is in nonattainment for the more stringent state PM_{10} standard.

Just as with the current FDE flight tests, rocket emissions from all three MM III stages would be rapidly dispersed and diluted over a large geographic area. Because the launches are short-term, discrete events, the time between launches would allow the dispersion of the emission products. No violation of air quality standards or health-based standards for non-criteria pollutants would be anticipated.

In terms of upper atmospheric effects, the combined release of hydrogen chloride, Al_2O_3, and NO_x emissions into the stratosphere from the four additional test launches would be insignificant because of the rapid dispersion predicted for such small quantities of substances. Thus, they would not have a significant impact on stratospheric ozone.

Under the proposed MM III modification, activities at Vandenberg AFB and at other locations would generate additional greenhouse gases (e.g., carbon dioxide and NO_x from motor vehicle emissions). Because the United States releases approximately 5,800 million metric tons of greenhouse gases annually (USEIA, 2003), the relatively small contribution of gases from the MM III modification would have an insignificant effect on global climatic change.

As part of the proposed deployment activities, electronic test and support equipment used during MM III flight test operations would be modified accordingly. The changes in equipment are minor and do not affect building or facility structures at Vandenberg AFB in any way. Therefore, no adverse effects on air quality would be expected from these activities.

4.3.2 Noise

4.3.2.1 No Action Alternative

Pre-Flight Preparations

Noise exposure from pre-flight activities is minimal. The noise generated during FDE pre-flight preparations comes primarily from the use of trucks and other load handling equipment. Any noise exposure levels must comply with USAF Hearing Conservation Program requirements, as described earlier in Section 3.3.2.

Flight Activities

For the three to four FDE MM III flight tests conducted every year, noise levels generated from each launch have minor variations resulting from changes in weather conditions, launch location, and launch trajectory. Figure 4-1 depicts the predicted maximum noise-level contours for a MM III launch from LF-26, the northernmost launch site used for Minuteman tests. The modeling results depicted in the figure represent a maximum predicted scenario that does not account for variations in weather or terrain. As shown in Figure 4-1, the noise levels generated can range from 125 dB (or higher) in the immediate vicinity of the launch site, to around 80 dB near Lompoc. Santa Maria can experience maximum noise levels of approximately 95 dB, while the community of Guadalupe may be exposed to maximum noise levels of around 105 dB. Because the noise levels shown in Figure 4-1 represent unweighted sound pressure levels, equivalent A-weighted sound levels would be substantially lower.

While these noise exposure levels can be characterized as very loud, they occur infrequently, are very short in duration (about 20 seconds per launch), and have little effect on the CNEL in these areas. Any USAF personnel and contractors working near the area at time of launch are required to wear adequate hearing protection in accordance with USAF Hearing Conservation Program requirements. In addition, public access areas near the Minuteman Launch Area are usually restricted at time of launch to ensure public safety and minimize unnecessary exposures. The helicopters used to verify that beach areas and near offshore waters are clear of non-participants generally limit their flights to the areas around the North Base, thus limiting the noise effects on local communities.

Sonic booms generated by the MM III missile typically start reaching the surface some distance downrange of the launch site. These sonic booms generally occur well off the coast over ocean waters, and so are not an issue affecting coastal land areas or the Channel Islands to the south. In addition, the sonic booms are typically audible for only a few milliseconds.

Based on this analysis, the ongoing actions of conducting up to four FDE launches per year would have no significant impact on ambient noise levels. The potential for launch noise and sonic boom impacts, on protected wildlife species and sensitive habitats, is discussed in Sections 4.3.3 and 4.4.1.

Post-Launch Operations

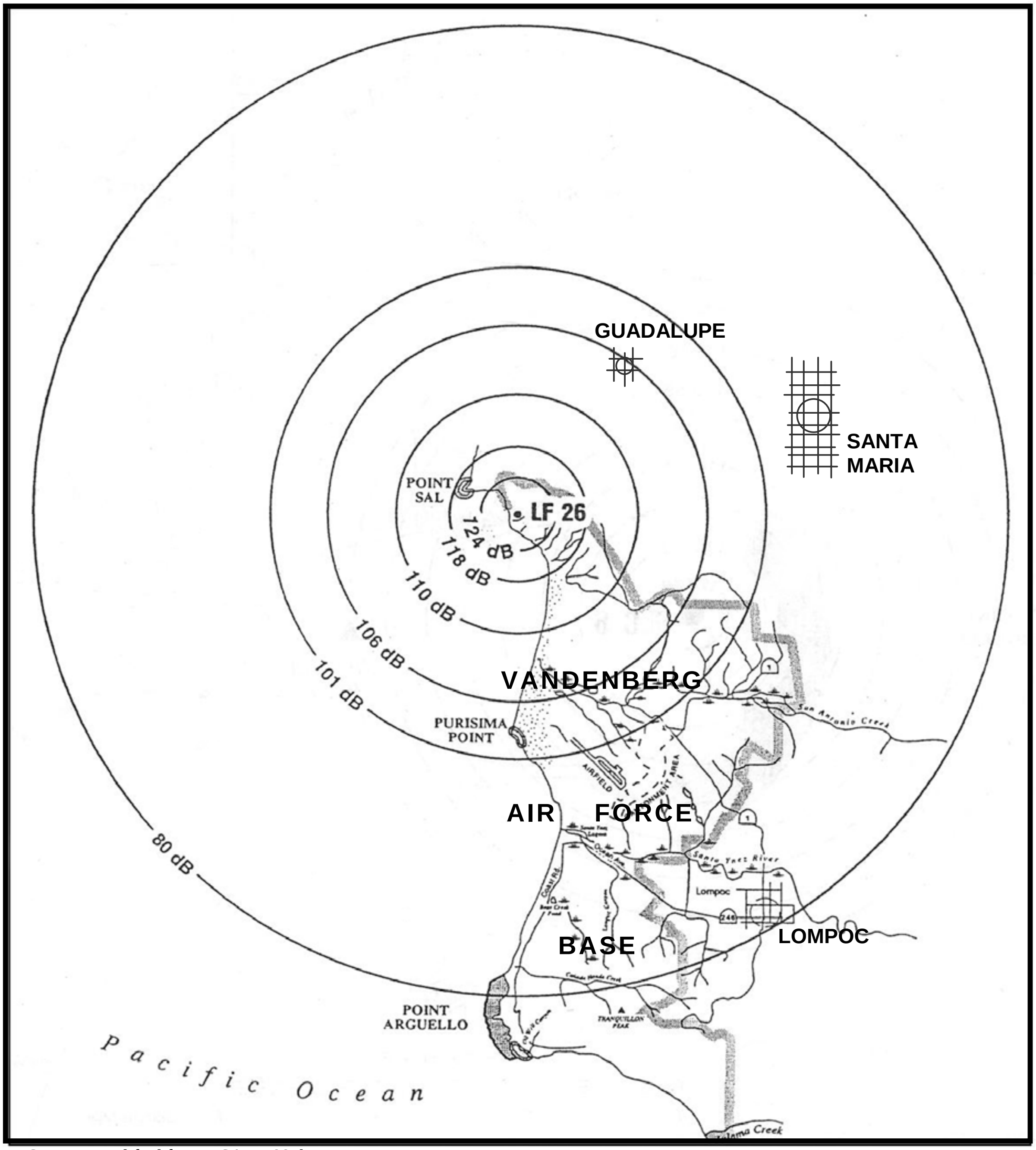
Because of the limited activities associated with post-launch operations, limited amounts of noise would be generated. Thus, no impacts to ambient noise levels are expected.

4.3.2.2 Proposed Action

The Proposed Action would involve a continuation of MM III launches from Vandenberg AFB. With the exception of two additional launches per year in FYs 2005 and 2006, operations and tests would be conducted in the same manner and at the same facilities as those used for the FDE flights described for the No Action Alternative. Any noise exposure levels would comply with USAF Hearing Conservation Program requirements. As a result, no impacts to ambient noise levels are expected during pre-flight preparations or for post-launch operations.

Proposed MM III launches would generate noise levels similar to those resulting from current FDE flight tests. This would include the use of helicopters to help clear non-participants from the area. Because the launch events are infrequent, discrete activities, ambient noise levels would not be affected substantially on an annual basis. Any noise impacts would be short term and not significant.

Just as with the current FDE flight tests, sonic booms resulting from the proposed flight tests would not affect coastal land areas or the Channel Islands to the south. Thus, no impacts on ambient noise levels in these areas would result.



Source: Modified from USAF, 1997b

Figure 4-1. Predicted Maximum Noise-Level Contours for a Minuteman Missile Launch

In addition, the equipment changes associated with the deployment activities would have no adverse effect on the noise environment.

4.3.3 Biological Resources

4.3.3.1 No Action Alternative

Pre-Flight Preparations

For pre-flight preparations at Vandenberg AFB, the intermittent movement of trucks and other load-handling equipment would not produce substantial levels of noise, and vehicles would normally remain on paved or gravel areas. Thus, it is expected that no adverse impacts on local wildlife or vegetation would occur from these limited activities.

Flight Activities

Under the No Action Alternative, three to four MM III FDE flight tests would continue to occur at Vandenberg AFB every year. Potential issues associated with normal launch operations include wildlife responses to helicopter activity, wildlife responses and potential injury from excessive launch noise, and the release of potentially harmful chemicals in the form of exhaust emissions. The release of unburned propellant from a possible launch failure or termination is also considered. The potential effects of these actions on the biological resources at Vandenberg AFB are described in the paragraphs that follow.

<u>Helicopter Overflights.</u> Base helicopters are flown over the ROI on the day of launch and possibly the day before to ensure launch hazard areas are clear of non-participants. Helicopter overflights have the potential to disturb marine mammals and birds, causing potential loss of eggs when birds fly from nests; separation of pinniped mothers from their offspring; and abandonment of favored resting, feeding, or breeding areas.

Under the terms of the MMPA, as amended, short-term behavioral effects on marine mammals must be considered. According to the MMPA, "harassment" means any act of "pursuit, torment, or annoyance" that has the potential to injure or disturb. MM III and other system launches at Vandenberg AFB have the potential to harass marine mammals. To address this issue, base personnel initiated a consultation with NMFS to obtain an annual letter of authorization (LOA) for these harassments, which are classified as a small number of "takes" incidental to activities (USAF, 1997b). A 5-year take permit was originally issued to Vandenberg AFB in 1997, and was later re-issued in February 2004 (69 FR 5720-5728). The incidental take permit allows the base to expose pinnipeds, including breeding harbor seals, to missile and rocket launches, and aircraft flight tests. The permit also authorizes incidental harassment of pinnipeds from helicopter overflights.

Prior observations of helicopter overflights in the launch hazard area have shown them to be a greater source of disturbance than the launches themselves (Bowles, 2000). Under the current NMFS permit and LOA, helicopters and other aircraft are required to maintain a minimum distance of 1,000 ft (305 m) from recognized seal haul-outs and rookeries (e.g., Point Sal and Lions Head) (69 FR 5720-5728). Because of Federal Endangered Species Act requirements, helicopters and other aircraft must also maintain a slant distance of not less than 1,900 ft (579 m) from California least tern and Western snowy plover nesting areas (from March 1 through September 30), and a year-round minimum 500 ft (152 m) slant distance from all identified Western snowy plover habitat areas on base (VAFB, 2002). These requirements can be modified only in emergencies, such as during search-and-rescue and fire-fighting operations. When helicopter flight restrictions are observed, there are negligible impacts on marine mammals and listed birds.

<u>Launch Noise.</u> Most of the energy in launch noise lies in the range below 1,000 Hertz (Hz), and often below 100 Hz. At low frequencies, pinniped hearing becomes progressively less sensitive (Kastak, et al.,

1999), forming the bottom of a "U" shaped curve that is typical of mammal hearing. For humans, the best measures of exposure account for this "U" shape by passing sounds through a filter called A-weighting, which removes low- and high-frequency noise before the level is calculated. The A-weighting function outperforms other functions as a filter where comparisons have been made (e.g., Sullivan and Leatherwood, 1993). It is not known whether similar weighting functions will be good measures of dosage for animals, but the technique has been tested using the harbor seal auditory threshold function and monitoring data being collected at Vandenberg AFB (SRS, 2000a). Because weighted measures for seals cannot yet be related to seal responses, it is not clear whether the method will be equally effective.

Noise levels produced by three MM III missile launches have been measured at varying distances from launch sites (Table 4-4). The closest monitoring site was 0.58 mi (0.94 km) from LF-26, which resulted in the highest unweighted noise measurement recorded during the three launches—133.6 dB. All three MM III launches occurred at night when few harbor seals were present on haul-out sites, and thus immediate behavioral responses could not be recorded. Three to four daily counts of seals were used to document occupancy on haul-out sites. After the June 7, 2002, launch, counts were comparable to those on previous days (pups were no longer present on the beach at the time) (SRS, 2002). Similar results have been found during launches of other systems. On the basis of prior monitoring studies, the NMFS has determined that rocket launch activities have a negligible impact on pinniped populations and stocks at Vandenberg AFB (67 FR 2820-2824).

Table 4-4. Summary of Minuteman III Launch Noise Measurements

Launch Date	Launch Facility	Distance from Monitoring Site to LF [mi (km)]	Unweighted Peak Sound Level (dB)	A-weighted Peak Sound Level (dBA)
November 13, 1999	LF-26	0.58 (.94)	133.6	130.5
May 24, 2000	LF-09	9.69 (15.60)	117.6	93.9
June 7, 2002	LF-26	1.96 (3.15)	121.2	117.1

Source: SRS, 2002

In terms of impacts on other wildlife species, counts before and after launches from Vandenberg AFB also have been used to document reactions of western snowy plovers, California brown pelicans, and southern sea otters. No evidence of mother-pup separation in southern sea otters, or abandonment of snowy plover nest sites, has been found during these studies. For example, monitoring studies conducted for a prior Atlas IIAS launch in 2001 showed no interruption of activities, nor any evidence of abnormal behavior or injury, for flocks of snowy plovers and brown pelicans. Therefore, a continuation of MM III launch noise is not expected to drive threatened and endangered species away from favored sites or to cause other significant behavioral disruptions. (SRS, 2000b, 2001a, 2001b)

Temporary changes in the animals' hearing threshold [temporary threshold shift (TTS)] are also possible as a result of launch noise. In a study at Vandenberg AFB, TTS was measured in three harbor seals using electrophysiological techniques after the seals were exposed to a Titan IV launch (SRS, 2000b). One hour after the launch, no TTS could be detected. Measurements were not made within a few minutes of the launch, so it is not known whether small shifts occurred initially or whether the seals would have experienced shifts at higher exposure levels. Similar results were obtained for Taurus launches from the base (69 FR 5720-5728).

As a means of assessing potential long-term effects of launch noise on pinnipeds, Vandenberg AFB will continue biological monitoring for all launches during the harbor seal pupping season (March 1 to June 30). A report detailing the results of each launch—including species, number of animals observed, behavior, reaction to launch noise, time to return to haul-out sites, and any adverse behavior—is then submitted to the NMFS. (69 FR 5720-5728)

Launch Emissions. The atmospheric deposition of launch emissions has the potential to harm nearby vegetation and acidify surface waters. The types and quantities of emissions products released from MM III launches are discussed in Section 4.3.1. The principal combustion product of concern is hydrogen chloride gas, which forms hydrochloric acid when combined with water.

As previously mentioned, areas immediately around the LFs are kept clear of vegetation in order to minimize the risk of brush and grass fires. Although localized foliar spotting from launch emissions is possible, such effects from larger launch systems have been shown to be temporary and not of sufficient intensity to cause long-term damage to vegetation (USAF, 2000a).

The acidification of surface waters in some of the small drainages and wetland areas, such as around Shuman Creek, could present harmful conditions for aquatic wildlife and some protected species. The bedrock and, by inference, the soils at Vandenberg AFB do not contain large amounts of acid-neutralizing minerals. However, the close proximity of the LFs to the ocean, combined with the prevailing onshore winds, causes the deposition of acid-neutralizing sea salt. The alkalinity derived from sea salt should neutralize the acid falling on soil, thus eliminating the potential for acid runoff. Surface water monitoring conducted for larger launch systems on Vandenberg's South Base has not shown long-term acidification of surface waters (USAF, 2000a). Because the MM III represents a smaller launch system producing fewer emissions, the potential for adverse effects is minimal.

Launch Failure or Early Flight Termination. In the unlikely event of a MM III failure during launch, or an early termination of flight, the missile would most likely fall into the ocean reasonably intact, along with some scattered debris. Pieces of unburned propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be widely dispersed. Of particular concern is the ammonium perchlorate. Once in the water, it can slowly leach out of the solid propellant resin binding-agent. Studies have shown that the rate of perchlorate extraction is a function of water temperature and salinity, with the highest rates observed at the highest temperature and lowest salinity (Lang, et al., 2002).

Effects of perchlorate on primary and secondary aquatic production, and on decomposition processes in sediments, wetland peat, and soil material, have recently been subject to laboratory studies. Aquatic primary production was affected only by perchlorate concentrations of 1,000 ppm, and this effect was minimal compared to control samples. Bacterial production was not adversely affected, except at very high levels in seawater samples. Since coastal waters are constantly circulating through wave action and currents, it is unlikely that phytoplankton or bacterioplankton would encounter such high levels of perchlorate for more than a few minutes. (Hines, et al., 2002)

It was also determined from these studies that respiration in marine and freshwater sediments, and wetland peat, was not adversely affected by perchlorate concentrations as high as 1,000 ppm. However, soil samples exhibited significant decreases in respiration activity in the presence of perchlorate at levels between 100 and 1,000 ppm. Therefore, it is possible that the deposition of perchlorate on coastal soils, following an aborted flight, could decrease the rate that material is decomposed in soil, which could adversely affect the recycling of nutrients and eventual plant growth. (Hines, et al., 2002)

The presence of potassium perchlorate at concentrations up to 10 ppm, and perchlorate concentrations nearing 30 ppm in laboratory aquariums containing solid propellant, had no effect on unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) mating or the birth and growth of fry. Fry mortality occurred in all treatments, but none were statistically different from controls. It is possible for the fry to experience morphological or behavioral abnormalities, but further studies would be needed. The laboratory study did demonstrate that perchlorate accumulated in both fish and the algal/bacterial community. Although no severe effects of perchlorate stress were detected, it is likely that the continued accumulation of perchlorate would lead to deleterious effects at some level. (Hines, et al., 2002).

In addition to solid propellants in the rocket motors, 13.2 gal (50 L) of liquid propellants contained in the PSRE could also be released on impact, assuming they have not been used for propulsion or vaporized during the destruct action. The toxicology of monomethylhydrazine and nitrogen tetroxide with marine life is not well known. Nitrogen tetroxide almost immediately forms nitric and nitrous acid on contact with water, and would be very quickly diluted and buffered by seawater; thus, would have little potential for harm to marine life. With regard to hydrazine fuels, these highly reactive species quickly oxidize, forming amines and amino acids, which are beneficial nutrients to simple marine organisms. Prior to oxidation, there is some potential for exposure of marine life to toxic levels, but for a very limited area and time. (NASA, 2002)

A lesser hazard may also exist from small amounts of battery electrolyte carried on the MM III missile. However, the risks from electrolytes are much smaller than the risks from propellants, due to the presence of smaller quantities, lower toxicity, and the use of more rugged containment systems for batteries (NASA, 2002).

The probability for an aborted MM III launch to occur is extremely low. If an early abort were to occur, base actions would immediately be taken for the recovery and cleanup of unburned propellants, and any other hazardous materials, that had fallen on the beach, off the beach within 6 ft (1.8 m) of water, or in any of the nearby freshwater creeks. Any recovery from deeper coastal water would be treated on a case-by-case basis. Any liquid or solid propellant falling into the offshore waters would be subject to continual mixing and dilution due to the ocean waves and currents, and hence, local accumulation of perchlorates contained in the propellants is unlikely. As a result, no significant impacts on biological resources would be expected.

Post-Launch Operations

The intermittent movement of trucks and any repair/cleanup/waste handling equipment would not produce substantial levels of noise, and vehicles normally would remain on paved or gravel areas. Thus, the limited actions associated with post-launch operations would have no adverse impacts on local wildlife or vegetation.

4.3.3.2 Proposed Action

For pre-flight preparations and post-launch operations, the intermittent use of trucks and equipment would occur, just as for the No Action Alternative. Thus, no impacts on biological resources are expected.

Currently, three to four MM III FDE launches are conducted from Vandenberg AFB every year. Under the Proposed Action, the FDE flights would continue, along with two additional launches per year in FYs 2005 and 2006. USFWS regulations for threatened and endangered species do not place a limit on the number of launches, as long as significant effects do not accrue as a result of additional launches. The NMFS permit authorizes marine mammal incidental takes for Vandenberg AFB launch programs, including MM launches from the North Base LFs.

Increases in the level of helicopter activity, as a result of additional MM III launches in FY 2005 and 2006, would be modest. Because helicopter approach restrictions established by the USFWS and NMFS already serve to protect bird and marine mammal species along the Vandenberg AFB coast, no change in risk is expected as a result of the launch operations.

The proposed flight tests would be indistinguishable in acoustic properties from MM III FDE flights already occurring at Vandenberg AFB. Therefore, no increase in noise effects on coastal marine birds or marine mammals would be expected.

The types of combustion products released, and the quantities released for each launch event, would be the same as that for the No Action Alternative. Emissions would be expected to dissipate quickly, and not result in any long-term effects on surface waters.

Additionally, the equipment changes associated with the deployment activities would have no adverse effect on biological resources.

Based on the overall analysis results, it has been determined that Section 7 consultation, under the Endangered Species Act, is not required for proposed activities at Vandenberg AFB.

4.3.4 Health and Safety

4.3.4.1 No Action Alternative

Pre-Flight Preparations

In preparation for flight tests, booster inspections, system checks, and the addition of test RVs and destruct packages are all routine activities at Vandenberg AFB. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations, would be followed, as well as all appropriate DOD and USAF regulations. By adhering to the established safety standards and procedures identified in Sections 3.1.1 and 3.3.4, the level of risk to military personnel, contractors, and the general public should be minimal. Consequently, no significant impacts to health and safety are expected.

Flight Activities

Adherence to the policies and procedures identified in Sections 3.1.1 and 3.3.4 protects the health and safety of on-site personnel. The establishment of Launch Hazard Areas (LHAs), impact debris corridors, beach and access road closures, and the coordination and monitoring of train traffic passing through the base, in addition to the NOTMARs and NOTAMs published for mariners and pilots, serves to protect the public health and safety. A safety analysis would be conducted prior to launch activities to identify and evaluate potential hazards and reduce the associated risks to a level acceptable to Range Safety. LHAs and impact debris corridors would be updated to provide MM III-specific parameters based on vehicle and payload configurations. As a result, no significant impacts to health and safety are expected.

Post-Launch Operations

Post-launch refurbishment and blast residue removal are routine operations at Vandenberg AFB. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations, would be followed, as well as all appropriate DOD and USAF regulations. By adhering to the established safety standards and procedures identified in Sections 3.1.1 and 3.3.4, the level of risk to military personnel, contractors, and the general public should be minimal. Consequently, no significant impacts to health and safety are expected.

4.3.4.2 Proposed Action

Pre-flight preparations, flight tests, and post-launch operations for the proposed MM III flight tests would be conducted in the same manner as described in Section 4.3.4.1, above, for the No Action Alternative. For the same reasons, no significant impacts to health and safety are anticipated.

4.3.5 Hazardous Materials and Waste Management

4.3.5.1 No Action Alternative

Pre-Flight Preparations

The motor inspections, system checks, and addition of test RVs and destruct packages are all routine activities at Vandenberg AFB. During pre-flight preparations, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.2. All hazardous and non-hazardous wastes would be properly disposed of in accordance with all Federal, state, local, DOD, and USAF regulations.

Flight Activities

Flight activities normally would not utilize any hazardous materials or generate any hazardous waste. If an early launch abort were to occur, base actions would immediately be taken to remove unburned propellant and any other hazardous materials that had fallen on the beach, off the beach within 6 ft (1.8 m) of water, or in any of the nearby freshwater creeks. Any recovery from deeper water would be treated on a case-by-case basis. Any waste materials collected would be properly disposed of in accordance with applicable regulations. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

Post-Launch Operations

The post-launch refurbishment and blast residue removal are all routine activities at Vandenberg AFB. During this process, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.2. All hazardous and non-hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

Console Equipment Maintenance

The replacement of aging or failed MM III command and control console equipment at Vandenberg AFB would not involve the direct handling of hazardous materials, but, as discussed in Section 4.1.2.1, would generate hazardous waste. However, through the local DRMO, equipment and other property containing hazardous materials or wastes are stored in facilities that ensure personnel protection, prevent accidents, and reduce the risk of environmental spills. The DRMS has in place programs for safety and training, storage and inspection, and special handling requirements that minimize risks to workers and the general public (DRMS, 2003). Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. As a result, no adverse impacts from the management of hazardous materials and waste are anticipated.

4.3.5.2 Proposed Action

Pre-flight preparations, flight tests, and post-launch operations for the proposed MM III flight tests would be conducted in a manner similar to that identified in Section 4.3.5.1, above, for the No Action Alternative. A slight increase in hazardous waste generated from post-launch refurbishment and cleanup for the additional launches in FY 2005 and 2006 would not exceed waste handling capacities or exceed permitted levels. Thus, for the same reasons as described for the No Action Alternative, no impacts from the management of hazardous materials and waste are anticipated.

The replacement of command and control console equipment, and related software upgrades, would occur at the MM III training and launch control facilities at Vandenberg AFB. Just as described for the Minuteman Wings in Section 4.1.2.2, the old EMAD cards would be returned to storage as spares and would not go to the on-site DRMO for disposition. For deployment of the new HDAs and VDUs, removal and disposal of the old units would generate hazardous waste consisting of trace amounts of cadmium and lead solder in each HDA, and approximately 4 lb (1.8 kg) of lead, and trace amounts of cadmium and barium, in each VDU. Table 2-4 identifies the approximate numbers of each console item that would be processed at the local DRMO. The proposed disposal of old console equipment would represent approximately 1 percent of current and ongoing DRMO work at Vandenberg AFB (Ogden ALC, 2003).

Overall, there should be no adverse impacts on current hazardous materials and waste management operations on base or at the DRMO facility.

As an alternative for DRMO processing, a few of the HDAs and VDUs could be considered for placement in the USAF Museum Program. However, no adverse impacts are expected from this particular action.

4.4 OVER-OCEAN LAUNCH CORRIDOR

The following sections describe the potential environmental consequences of the No Action Alternative and the implementation of the Proposed Action within the Pacific over-ocean launch corridor.

4.4.1 Biological Resources

Neither the current MM III FDE flight tests nor the proposed launches could have a discernible or measurable impact on benthic or planktonic organisms, because of their abundance, their wide distribution, and the protective influence of the mass of the Pacific Ocean around them. However, the potential exists for impacts to larger vertebrates in the nekton, particularly those that must come to the surface to breathe (i.e., marine mammals and sea turtles). Potential impacts on these species have been considered in this analysis and include the effects of acoustic stimuli produced by launches (sonic booms), and non-acoustic effects (splashdown of launch vehicle stages, and release of propellants or other contaminants into the water). Potential acoustic effects include behavioral disturbances, and temporary or permanent hearing impairment. Potential non-acoustic effects include physical impact by falling debris, and contact with or ingestion of debris or hazardous materials, particularly unexpended fuels. The resulting impact of a large, fast-moving object, such as the spent casing of a rocket motor, could cause either type of effect.

4.4.1.1 No Action Alternative

Launches from land have the potential to cause injury in the open ocean environment. Launch noise will decline rapidly as MM III missiles ascend to the stratosphere, becoming indistinguishable from passing commercial jet noise within 5 minutes of launch. As the missile accelerates to supersonic speeds, it will produce a sonic boom that reaches the ocean surface. When spent motor stages and other debris fall to the ocean surface, there is an extremely small probability that marine mammals or sea turtles could be struck, or injury could occur from the shock/sound wave that propagates through the water away from the site of impact. If the vehicle fails or is terminated during its flight, unburned fuel could also be deposited at sea. These issues are further discussed in the following paragraphs.

Sonic Boom Overpressures

A recent noise study of the MM III launches from Vandenberg AFB modeled the sonic boom levels generated downrange (Tooley, et al., 2004). The modeling results show that sonic boom overpressures at the ocean surface are typically near their maximum level at a distance of about 25 nautical miles (46 km) due west of the launch site. The surface footprint of the sonic boom can extend outward several miles on each side of the flight path, but it quickly dissipates with increasing distance downrange. At the ocean surface, peak overpressures were estimated to be in the 3.5 to 9.2 psf [138 to 149 dB (referenced to 20 µPa)] range in air, based on typical atmospheric wind conditions. The duration of these overpressures is less than 250 milliseconds.

The propagation of sonic booms underwater could affect the behavior and hearing sensitivity in marine mammals (primarily cetaceans), sea turtles, and other fauna. If the sounds were to be strong enough, they might cause animals to quickly react, altering (briefly) their normal behavior. Such behavioral reactions might include startle or annoyance responses, and brief changes in surfacing and/or diving activities. Studies have shown such reactions to occur in small cetaceans at underwater pressures as low as 178 dB (referenced to 1 µPa). (Richardson, et al., 1995; Schlundt, et al., 2000)

As mentioned earlier, TTS shifts are decreases in hearing sensitivity that recover over time. When measured within a few minutes of exposure, small TTS values can be used as a lower estimate of the threshold for unsafe exposures to acoustic pressures. At higher pressure levels, TTS reaches a maximum, above which permanent hearing loss may occur. In defining pressure levels that initiate TTS in marine mammals, research has shown the onset of TTS (from a single underwater pulse) to occur within a range of approximately 12 to 23 pounds per square inch (psi) peak pressure, or 218 to 224 dB (referenced to 1 µPa) (Finneran, et al., 2002; Ketten, 1995). The 12-psi peak underwater pressure level has also been used by the NMFS as a criterion for determining Level B acoustic harassment for all marine mammals[5], in accordance with the MMPA (69 FR 2333-2336; 69 FR 29693-29696).[6] (For further discussions on criteria for behavioral reactions and TTS, refer to Section 4.5.1.1 in this EA.)

Theoretical models for sonic booms generated by a large space launch vehicle (Titan IV) have shown that peak underwater pressures are likely to be on the order of 130 to 140 dB (referenced to 1 µPa), or less than 0.0015-psi peak pressure (HKC Research, 2001), well below the 178-dB and 218-dB (12-psi peak

[5] Level B acoustic harassment is defined as the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (69 FR 29693-29696).

[6] Interpreting the effects of noise on marine mammals and sea turtles depends on various parameters, including the sound exposure level and duration, the sound frequency, and the animals hearing ability. In recent years, biological literature on marine mammals and acoustic effects has tended to use (1) peak pressure levels expressed in either psi, or dB referenced to 1 µPa; (2) the average or root-mean-square level over the duration of the sound, also expressed in dB referenced to 1 µPa; and/or (3) the sound energy flux density, which is the average rate of flow of sound energy over an appropriate time, such as the duration of the first positive pressure, expressed in dB referenced to 1 micro Pascal-squared·seconds ($\mu Pa^2 s$). Because the expected underwater noise levels from sonic booms represent single pulses that are relatively low in acoustic strength, and very short in duration (less than 250 milliseconds), peak pressure levels were used for analysis purposes.

pressure) lower limits for inducing behavioral reactions and TTS (respectively) in marine mammals.[7] Because sonic boom underwater pressures caused by the smaller MM III vehicle are expected to be less than those of larger space launch vehicles, the sonic booms should not result in any long-term adverse effects to marine mammals. This is particularly evident when considering the following:

- Sonic booms generated by MM III launch vehicles are very short in duration (lasting less than 250 milliseconds).
- MM III flight tests occur only 3 or 4 times per year.
- The probability for marine mammals to be within the sonic boom footprint out in the open ocean is reasonably low.

As for sea turtles, no specific behavioral reaction or TTS data has been identified, and the potential for effects on their hearing is still unknown. However, turtles are less sensitive with respect to hearing than birds and mammals as a group. If peak overpressure levels are considered safe for marine mammals, then they should not pose a risk to sea turtles. (USN, 2001b; Wever, 1978)

Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

At the velocity of their normal descent, the spent rocket motors would each hit the ocean surface at speeds ranging from 195 to 230 ft (59 to 70 m) per second (Tooley, et al., 2004). Weighing between 1,105 and 4,902 lb (501 and 2,224 kg) each, the three expended MM III motors would have considerable kinetic force. Upon impact, this transfer of energy to the ocean water would cause a shock wave (low-frequency acoustic pulse) similar to that produced by explosives. Recent modeling studies for MM III flight tests have shown that underwater noise pulse levels would be on the order of 0.4 to 0.8 psi at a range of 164 ft (50 m) from the motor's impact point (Tooley, et al., 2004). In the water, this would feel like a "sharp push." At such distances, the resulting shock wave is not expected to cause any injuries to marine mammals and sea turtles. However, for distances that are much closer to the impact point, the shock wave might injure internal organs and tissues, or prove fatal to the animals. These findings are consistent with other studies that agree fairly closely on an approximate 240-dB (referenced to 1 µPa and equal to 145 psi) baseline criterion for defining physical injury or death for marine mammals (Ketten, 1998). Such pressure levels would occur only within several feet of the rocket motor impact points. With increasing distance from the impact point, pressure levels would decrease, as would the risk for injury to animals.

If any portion of the MM III launch vehicle were to strike a protected marine mammal or sea turtle near the water surface, the animal would most likely be killed. However, risks of injury to any marine mammal or sea turtle by direct impact or shock wave would be extremely small. Analyses conducted at the Point Mugu Sea Range off the coast of Southern California (USN, 2002) have determined that there is a very low probability for marine mammals to be killed by falling boosters, targets, or other missile debris, or from the resulting shock wave of a missile impacting the water. These studies show the cumulative number of animals expected to be injured or killed ranged from 0.0006 for US territorial waters to 0.0016 for non-territorial waters, for all related missile operations conducted over 1 year. The probability calculations were based on the densities of marine mammals in the ocean areas where activities are conducted, the number of activities, and the area of influence of the activity (NAWCWPNS

[7] In determining when the onset of behavioral reactions and TTS might occur in marine mammals, acoustical pulse criteria were based largely on studies with small odontocetes (toothed whales). Because comparable data for other cetacean groups [e.g., mysticetes (baleen whales)] are not available, the analysis conducted in this EA assumed that the behavioral reaction and TTS data collected for small odontocetes are applicable to other whale species.

Point Mugu, 1998). The numbers are low enough that the probability for animal injuries from falling debris can be considered negligible.

Another potentially adverse effect of the underwater shock waves caused by the spent rocket motors is that the acoustical pulse generated may induce behavioral reactions or TTS in protected marine mammals, and possibly in threatened and endangered sea turtles as well. As mentioned earlier, studies have shown that behavioral reactions in marine mammals can occur at pressure levels as low as 178 dB (referenced to 1 µPa), while the onset of TTS can occur within the range of 218 to 224 dB (referenced to 1 µPa), or 12- to 23-psi peak pressure.[8, 9] Underwater pressure levels capable of inducing behavioral reactions in marine mammals are not expected to occur much beyond a few hundred yards from the motor impact points, particularly for the heavier 1st-stage motor. Pressure levels for inducing TTS, however, would only occur within a few yards of the motor impact points. In the open ocean, the probability of impacting protected marine mammals and sea turtles is insignificant, based on statistical analyses. The MM III flight tests would occur only 3 to 4 times per year, and motor impacts from each flight would likely not occur at the exact same locations. As a result, the noise pulses generated from the impacts of spent rocket motors are not expected to cause any long-term adverse effects on marine mammals or sea turtles in the open ocean.

Contamination of Seawater

When the spent rocket motors impact in the ocean, no solid propellant would be remaining in them. The residual aluminum oxide and burnt hydrocarbon coating the inside of the motor casings would not present any toxicity concerns. Though the batteries carried onboard the rocket motors would be spent (discharged) by the time they impact in the ocean, they would still contain small quantities of electrolyte material. These materials, along with residual amounts of hydraulic fluid and strontium perchlorate contained in the 1st- and 3rd-stage motors (respectively), may mix with the seawater, causing contamination. The release of such contaminants could potentially harm marine life that comes in contact with, or ingests, toxic levels of these solutions.

The National Aeronautics and Space Administration (NASA) previously conducted a thorough evaluation of the effects of rocket systems that are deposited in seawater. It concluded that the release of hazardous materials, carried onboard launch vehicles, would not be significant. Materials would be rapidly diluted in the seawater and, except for the immediate vicinity of the debris, would not be found at concentrations identified as producing adverse effects (PMRF, 1998). Ocean depths in the ROI reach thousands of feet and, consequently, any impacts from hazardous materials are expected to be minimal. The area affected by the dissolution of hazardous materials onboard would be relatively small because of the size of the rocket components and the minimal amount of residual materials they contain. Such components would immediately sink to the ocean bottom, out of reach of marine mammals, sea turtles, and most other marine life. Though it is possible for deep ocean, benthic species to be adversely affected by any remaining contaminants, such impacts would be very localized, occurring within a short distance to rocket debris deposited on the ocean floor. Consequently, no significant impacts to biological resources are expected from the contamination of seawater.

Failed or Terminated Launch

In the unlikely event of a missile system failure during launch, or an early termination of flight, the missile would fall to the ocean intact or as debris scattered over a large area. It is expected that the falling

[8] For similar reasons explained in footnote 6, peak pressure levels were used in the analysis of underwater shock/sound waves generated by spent rocket motors impacting in the open ocean.

[9] See footnote 7.

missile and its debris would not have a significant impact on biological resources because of the large expanse of the ocean area and the very low probability of striking a marine mammal or sea turtle.

Initiating flight termination after launch would split or vent the solid propellant motor casing, releasing pressure and terminating propellant combustion. Pieces of unburned propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be dispersed over an ocean area of up to several square miles. Of particular concern is the ammonium perchlorate, which can slowly leach out of the solid propellant resin binding-agent once the propellant enters the water. However, as previously described in Section 4.3.3.1, it is unlikely that perchlorate concentrations would accumulate to a level of concern. The overall concentration and toxicity of dissolved solid propellant from the unexpended rocket motors, or portions of them, is expected to be negligible and without any substantial effect. Any pieces of propellant expelled from a destroyed or exploded rocket motor would sink hundreds or thousands of feet to the ocean floor. At such depths, the material would be beyond the reach of most marine life.

The liquid propellants (monomethylhydrazine and nitrogen tetroxide) contained in the PSRE could also be released in the ocean waters on impact, assuming they have not been used for propulsion or vaporized during the destruct action. Wave actions and ocean currents would quickly mix and dilute the liquid propellants, in addition to them being buffered or oxidized in the seawater, thus eliminating potentially toxic concentrations (see Section 4.3.3.1). Should the sealed propellant assemblies within the PSRE survive ocean impact intact, they would sink to great depths and settle on the ocean floor. There, they could potentially leak propellants into the water over time. As with the solid propellants, the liquid propellants would be beyond the reach of most marine life. Though it is possible for deep ocean, benthic species to be adversely affected by any remaining contaminants, such impacts would be very localized, occurring within a short distance to launch vehicle debris deposited on the ocean floor.

In summary, missile flight test flights would have no discernible effect on the ocean’s overall physical and chemical properties, and thus should have no impacts on the overall marine biology of the ROI. Missile flight tests would result in minimal risk of hitting or otherwise harassing marine mammals or sea turtles. Moreover, such tests would have no discernible effect on the biological diversity of either the pelagic or benthic marine environment. Consequently, no significant impacts to biological resources in the ROI would be anticipated.

4.4.1.2 Proposed Action

Though the MM III launch rate would increase in FYs 2005 and 2006, launches would still occur at an average rate of one launch every 2.4 months. Therefore, the potential for damage in the over-ocean launch corridor from proposed launch activities would not be much different than that of the No Action Alternative.

Launch Noise and Sonic Boom Overpressures

The proposed MM III launches would not produce sonic boom peak overpressures that are any greater than those generated by current MM III FDE launches. Therefore, no change in the risk of injury in the over-ocean launch corridor is expected.

Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

When compared to the MM III FDE launches under the No Action Alternative, the additional launches proposed would only slightly increase the risk of injury to marine mammals over the FYs 2005 and 2006 timeframe. Splashdown locations would still be confined to deep ocean waters, as is the case for current FDE launches.

Contamination of Seawater

Initially, the proposed launches would marginally increase the risk of seawater contamination and risks to the marine environment for a 2-year period. However, as with the No Action Alternative, the area affected by the slow dissolution of hazardous materials onboard would be relatively small because of the size of the rocket components and the amount of residual materials they contain. Such components would immediately sink to the ocean bottom, out of reach of marine mammals, sea turtles, and most other marine life.

Launch Failure or Termination

Under the Proposed Action, the risk of launch termination would not be significantly greater than that for current MM III FDE launches. Effects of a launch failure, should one occur, would also be the same as for an FDE launch.

In summary, the effects of the additional MM III flight tests on protected marine mammals, sea turtles, and other marine life would not be much different than those already described for the No Action Alternative in Section 4.4.1.1. Thus, no significant impacts to biological resources in the ROI would be anticipated.

4.5 US ARMY KWAJALEIN ATOLL

The following sections describe the potential environmental consequences of the No Action Alternative and the implementation of the Proposed Action at USAKA in the RMI. This analysis of the proposed RV tests at USAKA expands on an earlier analysis contained in the *Environmental Assessment for Department of Energy (DOE) Reentry Vehicles, Flight Test Program, US Army Kwajalein Atoll, Republic of the Marshall Islands* (USAF, 1992a), which is summarized in Appendix A.

4.5.1 Biological Resources

4.5.1.1 No Action Alternative

Currently, MM III RVs impact in the deep ocean waters east of Kwajalein Atoll or in the vicinity of Illeginni Island, as indicated on Figure 2-12. A sonic boom and the acoustic component of the splashdown shock wave have the potential to cause impacts both above and below the water in the immediate vicinity of the impact site. The force of an RV impacting directly on Illeginni or in the shallow reefs nearby can produce a crater, and harm nearby wildlife and marine resources. The release of Be, DU, and other contaminants from some RV tests is also considered.

Sonic Boom Overpressures

As each descending test RV approaches Kwajalein Atoll at hypersonic velocity, sonic booms are initially generated over a very broad area of the open ocean northeast of the Atoll and continue in a southwesterly direction towards the point of impact, where the sonic boom footprint narrows to just a few miles on either side of the flight path. At the ocean surface, the sound pressure levels for the sonic booms would vary from 91 dB (referenced to 20 µPa) at the eastern-most range and increase to 150 dB (referenced to 20 µPa) at the western-most range, close to the point of impact (Moody, 2004b). For those RVs that impact east of the Kwajalein reef, the sonic boom footprint would occur almost entirely over open ocean. For those RVs targeted in the vicinity of Illeginni Island, the sonic boom footprint would overlap most of the Mid-Atoll Corridor, including several islands of the Atoll. The duration for sonic boom overpressures produced by the RVs ranges from 40 milliseconds where the boom is strongest to 124 milliseconds where it is weakest (Moody, 2004b).

Migratory seabirds and shorebirds forage, roost, and nest on some of the barrier islands of Kwajalein Atoll. At Illeginni Island, the migratory bird population appears to be stabilized, if not increasing. As has been reported at other sites (Awbrey, et al., 1991; Schreiber and Schreiber, 1980), birds exposed to repeated sonic booms can become habituated. Birds in the general area may exhibit brief flight responses, but they are not expected to abandon nests.

In terms of underwater impacts, the sonic booms would generate peak underwater pressures ranging from 117 dB (referenced to 1 µPa) at the eastern end of the sonic boom footprint to 176 dB (referenced to 1 µPa) at the western end of the footprint, near the point of impact (Moody, 2004b).[10] Though the sonic booms generated by the RVs are expected to be audible or perceived by marine mammals in the affected area, later discussions will show that no long-term adverse effects are anticipated.

Exposure to intense sound can cause behavioral reactions in marine mammals and sea turtles, which may include cessation of resting, feeding, or social interactions; changes in surfacing, respiration, or diving cycles; and avoidance reactions, such as vacating an area. Higher sound level exposures for these animals may increase the hearing threshold to a new level where, as at the new post-exposure threshold, any sound must be stronger than before in order to be heard. If this hearing threshold shift returns to the pre-exposure level after a period of time, the threshold shift is referred to as a TTS resulting from a recoverable loss of hearing function. TTS can be characterized by a short-term impairment in the ability for marine mammals and other fauna to communicate, navigate, forage, and detect predators. If the threshold shift does not return to the pre-exposure level, it is a permanent threshold shift (PTS) caused by a permanent loss of hearing function. (68 FR 17909-17920; Kastak, et al., 1999; Richardson, et al., 1995)

Single or occasional occurrences of mild TTS do not cause permanent auditory damage in terrestrial mammals, or in marine mammals. However, very prolonged exposure to sound strong enough to cause a TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals. The magnitude of TTS depends on the sound pressure level and duration of noise exposure, among other factors. For single, short duration sound impulses, higher pressures may be tolerated before the onset of a TTS occurs, when compared to longer duration pulses or repeated sound exposures at lower pressures. (68 FR 17909-17920; Finneran, 2004; Finneran, et al., 2002; Kastak, et al., 1999; Nachtigall, et al., 2003; and Schlundt, et al., 2000)

In determining behavioral reactions in marine mammals, prior studies of humpback whales (*Megaptera novaeangliae*) have generally showed no strong reactions to acoustic pulses of approximately 150 dB (referenced to 1 µPa) resulting from large explosions 1.15 mi (1.85 km) away. It is uncertain, however, whether the whales had become habituated to the blasting activities before observations began. In another study, captive false killer whales (*Pseudorca crassidens*) showed no obvious reaction to small explosions producing single noise pulses of approximately 185 dB (referenced to 1 µPa). When exposed to intense 1-second tones in a netted enclosure, bottlenose dolphins (*Tursiops truncatus*) began to exhibit altered behavior at levels of 178 to 193 dB, while white whales (*Delphinapterus leucas*) displayed altered behavior at 180 to 196 dB. The behavioral reactions, in this case, were defined as deviations from the animals' trained behaviors, which included startle or annoyance responses. (Richardson, et al., 1995; Schlundt, et al., 2000)

The noise level associated with the onset of TTS is often considered to be the level below which there is no danger of injury to animals (68 FR 17909-17920). Though only a few data on sound levels and

[10] See footnote 6.

durations necessary to elicit mild TTS have been obtained for marine mammals (68 FR 17909-17920), a review of literature from earlier studies has shown 210 to 220 dB (referenced to 1 µPa and equal to 5 to 15 psi, respectively) as the lower limit for inducing mild TTS in marine mammals (Ketten, 1998). Consistent with these pressure levels, the NMFS, in defining Level B acoustic harassment criteria for all marine mammals, has used 218 dB (referenced to 1 µPa and equal to 12 psi peak underwater pressure) [cited by Ketten (1995)] as associated with a safe outer limit for minimal, recoverable auditory trauma (i.e., TTS) (69 FR 2333-2336; 69 FR 29693-29696).

More recently, extensive threshold studies conducted on the white whale have shown no substantial TTS when exposed to multiple, short duration acoustic pulses at 221 dB (referenced to 1 µPa) peak pressure. At 224 dB (referenced to 1 µPa and equal to 23 psi), however, TTS did occur, resulting in a 6- to 7-dB temporary reduction in hearing ability. Similar studies of the bottlenose dolphin have shown no TTS at peak pressure levels up to 226 dB (referenced to 1 µPa and equal to 30 psi) (Finneran, et al., 2002). Both bottlenose dolphins and white whales have been used for such studies because they have hearing ranges and sensitivities equivalent to or better than many marine mammals. Thus, these two animals may be representative of other species with broad auditory bandwidth and high sensitivity (Finneran, et al., 2000).[11]

As for permanent hearing loss, no published data for the occurrence of PTS in marine mammals is currently available. Experiments conducted with small cetacean species—where low-level threshold shifts (less than 10 dB) occurred—did not result in PTS. Though PTS has been observed in terrestrial animals, the level of single-sound exposures must be far above the TTS threshold for any risk of permanent hearing damage. For example, studies of terrestrial animals exposed to single noise impulses have shown that threshold shifts of up to 40 dB may be fully recoverable (i.e., with no PTS). (68 FR 17909-17920; Finneran, et al., 2000, 2002; Richardson, et al., 1995; Schlundt, et al., 2000)

Based on the above information, an acoustical pulse of 178 dB (referenced to 1 µPa) was used to represent the lower limit for inducing behavioral reactions in marine mammals (cetaceans and dugongs), while 218 to 224 dB (referenced to 1 µPa and equal to 12 to 23 psi peak underwater pressure, respectively) was used in this analysis for determining when the onset of TTS might occur.[12] As a result, the peak underwater pressures produced by RV sonic booms [117 to 176 dB (referenced to 1 µPa)] would fall just below the lower limit for inducing behavioral reactions (178 dB), and well below the lower limit for TTS (218 dB). Thus, no PTS or other long-term adverse impacts on protected marine mammals are expected. As discussed earlier in Section 4.4.1.1, threatened and endangered sea turtles also should not be adversely affected at these pressure levels. These findings are more evident when considering the following RV test characteristics:

- Sonic booms generated by RVs are very short in duration, lasting only a fraction of a second
- RV flight tests occur only 3 or 4 times per year
- RV flight paths and targeting areas are not always the same.

[11] As an example of how longer duration, steady-state sound exposures can affect TTS levels in marine mammals, bottlenose dolphins exposed to 179 dB (referenced to 1 µPa) for up to 54 minutes experienced TTS levels averaging 11 dB (Nachtigall, et al., 2003). Because the underwater shock/sound waves generated by sonic booms or falling missile components are single, short duration pulses (measured in milliseconds), sound pressure levels necessary to induce TTS in marine mammals are expected to be much higher.

[12] It is important to note that the acoustical pulse criteria used for determining the onset of behavioral reactions and TTS are based largely on studies with small odontocetes (toothed whales). Because comparable data for other cetacean groups [e.g., mysticetes (baleen whales)] and some other marine mammal groups [e.g., sirenians (including dugongs)] are not available, the analysis conducted in this EA assumed that the behavioral reaction and TTS data collected for small odontocetes are applicable to other whale species and dugongs occurring at USAKA.

Chemical Release

Following an airburst or ocean/lagoon impact by a test RV, the resulting debris would disseminate any on-board hazardous materials around the impact point and some distance downwind. However, the DU and Be particles or fragments deposited by some RVs are very insoluble. The rates of dilution for DU and Be are significantly greater than their rates of dissolution in water, which ensures that the concentrations would not exceed background levels. Fine particles would eventually be distributed in the sediment and be of no consequence to marine species, while any larger fragments would be recovered from the lagoon or from shallow ocean waters for proper disposal (see Section 4.5.4). (USAF, 1992a)

The batteries carried onboard an RV would be spent (discharged) by the time the vehicle impacts land or water at USAKA and, thus, would also be of little concern. For the batteries carried on each test RV, the quantity of electrolyte material would amount to no more than 2.13 ounces (64 milliliters) of potassium hydroxide. Some test RVs would also contain about 0.2 lb (0.09 kg) of lithium compounds in other batteries. Considering the small quantities of hazardous materials contained in the batteries, and the dilution and mixing of the ocean and lagoon waters, the battery materials released during an airburst or at impact should be of little consequence to marine life in the area. Any battery fragments found in the lagoon or in other shallow waters, during recovery and cleanup operations, would be removed.

Though no cleanup or recovery operations would be conducted for an ocean impact in deeper water [depths greater than 50 to 100 ft (15 to 30 m)], the small amounts of hazardous materials released would result in little or no adverse impacts to marine life. This is particularly true when considering the wide dispersal of materials following impact, the rapid dilution of battery electrolytes in the ocean water, and the low solubility of the Be and DU materials.

Potential ecological effects on Illeginni Island can be assessed on the basis of deposition and concentration patterns observed from prior RV tests on land. Debris and ejecta occur close to the point of impact, mostly within a 328-ft (100-m) radius. It is expected that very little of the RV battery materials would survive impact. For the DU and Be, the deposition of small particles can contribute to elevated levels in soil in the immediate vicinity of the impact point and extend downwind. An earlier RV test at Illeginni resulted in soil concentrations of only 5 ppm of Be in the area of highest deposition (USAF, 1992a). For comparison purposes, this concentration falls in the low end of the range of naturally occurring Be found in soils in the United States, which ranges from 0.1 to 40 ppm (ANL/DOE, 2002). The Be remains bound to the soil within the environmental pH range of 4 to 8 and does not dissolve in water, thus preventing release to ground water (USEPA, 1998). Furthermore, Be is not likely to be found in natural water (within normal pH ranges) in greater than trace amounts, because of the extreme insolubility of the material (NAS-NRC, 1977).

For the DU particles deposited on the ground, studies have shown that low levels of soluble U will travel very slowly through soil and are subject to adsorption as they pass through the soil (DOD, undated; Stegnar and Benedik, 2001). The transport of U with rainwater runoff is limited because of its low solubility and high density (DOD, undated). Even under extreme hydraulic conditions within a laboratory, the probability for significant surface water transport of DU from soil appears to be low (WRRC, 1995). Possible DU contamination of ground water from vertical migration has also been shown to be highly unlikely (DOD, undated).

The concentrations of soluble Be in soil will be orders of magnitude below the observed phytotoxicity concentration of 2 ppm soluble Be (USAF, 1992a). Plants also do not readily absorb U from soil (Stegnar and Benedik, 2001). In view of the very low solubility and limited transport of Be and DU in soil and water, it is not likely that these materials would have any serious adverse effects on plants at Illeginni, or on the animals that might feed on those plants. Be and DU must be in the dissolved form to be absorbed by plants and animals. Since the Be and DU concentrations in the dissolved form would be below background levels, no significant impacts on plants and animals are expected. Though there is the potential for migratory birds on the island to breath respirable dust particles of Be and DU, or consume particles deposited on vegetation, exposures (through breathing or feeding) to significant levels of these materials are not expected because of the small amount of unrecovered material that may persist in the environment.

Beyond 164 ft (50 m) from the impact crater, under probable meteorological conditions, there is deposition on the water surface. The process of mixing Be and DU particles by tide and surf would rapidly dilute the small amounts deposited, and considering the low solubility of the Be and DU, resulting concentrations would be low and non-toxic to fish, sea turtles, coral, and other marine invertebrates along the reef. Eventually, the Be and DU are deposited as sediment, where they would slowly weather just as they do in the soil (USAF, 1992a). Thus, the overall health of the coral reef should not be affected.

Airburst tests would be performed entirely over water. The MM III flight test RVs would be targeted farther away from Illeginni Island in order to minimize the drift of debris and fine particulates from the airbursts toward Illeginni, and to ensure that their impacts on plants and animals in the vicinity of the island would be insignificant.

Based on existing data, definitive conclusions on risks to animal species and human health cannot be reached. For this reason, soil, sediment, and tissue samples have been taken at Illeginni Island, and along the shorelines and shallow marine environments of the lagoon and ocean side of the island. Though the sampling effort at Illeginni has already been completed, the analytical results for the samples collected are not expected until late 2004. Once the sampling results are known, the information will be utilized in determining the need for further investigation in consultation with the USFWS, NMFS, USEPA, and RMIEPA, and if additional mitigation measures are warranted.

Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

An RV impacting in the ocean or USAKA lagoon would result in underwater shock/sound waves comparable to the splashdown of the MM III rocket motors described earlier in Section 4.4.1.1, but with much greater force because of the vehicle's hypersonic velocity at the time of impact. Whether or not the test RV contains a high explosives package makes little difference in the formation of shock/sound waves. The resulting underwater waveform in either case would last only about 10 to 30 milliseconds. (Moody, 2004a; Tooley, et al., 2004)

As described earlier, behavioral reactions in marine mammals can begin to occur at pressure levels as low as 178 dB (referenced to 1 µPa), while the onset of TTS has been determined to occur at peak pressure levels of about 218 to 224 dB (referenced to 1 µPa and equal to 12 to 23 psi, respectively), depending on the species and only for occasional, short-term exposures.[13] Based on the underwater acoustic impulse produced by an RV impact, minimum pressure levels for inducing behavioral reactions in some marine mammals could occur within a few thousand yards of the impact point. As the distance to the impact point decreases, resulting pressure levels would increase and, thus, increase the potential for altered behavior to occur. For any marine mammals in this area, reactions might include abrupt movements, changes in surfacing, and sudden dives. These behavioral reactions, if they occur, would last for a very

[13] See footnote 12.

brief period and not result in any long-term affects. For reasons described in Section 4.4.1.1, it is expected that sea turtles would be less affected in terms of behavioral reactions.

In regards to potential TTS, distances from RV impacts for when the onset of TTS might occur in marine mammals are presented in Table 4-5. As the table shows, this distance ranges from 62 to 128 ft (19 to 39 m), depending on which sound pressure level is used. For this analysis, it is presumed that sea turtles would also fall within this range for TTS occurrence.

Table 4-5. Reentry Vehicle Impact Distances for the Onset of Temporary Threshold Shift (TTS) in Marine Mammals

Sound Pressure Level (dB ref to 1 μPa)	Equivalent Underwater Peak Pressure (psi)	Radial Distance from the Point of RV Impact [1] [ft (m)]	Reference for Pressure Level
218	12	128 (39)	69 FR 2333-2336 69 FR 29693-29696 Ketten (1995)
224	23	62 (19)	Finneran, et al. (2002)

Notes:
[1] Radial distances were calculated in accordance with methods described in Moody (2004a).

At distances less than 62 ft (19 m) from the RV impact point, it can be expected that marine mammals and sea turtles might suffer PTS and/or other injuries. An underwater pressure level of approximately 240 dB (referenced to 1 μPa and equal to 145 psi) is considered the baseline criterion for defining physical injury or death for marine mammals (Ketten, 1998). Such pressure levels would only occur within several feet of the RV impact point. With increasing distance from the RV impact point, pressure levels would decrease, as would the risk for injury to animals. The ranges of impact distances for the onset of TTS, and for determining physical injury/death, are illustrated in Figure 4-2. Because the 218-dB (referenced to 1 μPa) level represents the lowest pressure level for when TTS might occur, it can be considered the outermost limit for potential harm to marine mammals, as well as for sea turtles.

Because the USAKA survey data described in Section 3.5.1 is qualitative in nature, probabilities for determining potential underwater shock/sound wave impacts on protected marine mammals were based on surrogate data from the sea range at PMRF, Hawaii, which has higher species densities than the Illeginni Island vicinity. Using the sound pressure levels identified earlier in Table 4-5, probabilities for the number of groups (pods or schools) of marine mammals that could potentially be impacted by a single RV are presented in Table 4-6 for the onset of TTS, and for physical injury/death. As the results show, the probability for animals to be struck or exposed to the harmful affects of the underwater shock/sound waves is estimated to be no higher than 3 in one million, or 0.000003. For two or three RV simulators to be used in a single test event, the probabilities would be 0.000006 or 0.000009, respectively. Because sea turtles generally have been shown to occur in smaller numbers, when compared to marine mammals, the resulting probabilities for impacts on them would be even less.

Because of the higher-pressure levels generated underwater by RV impacts, energy flux density values were also calculated and are presented in Table 4-6 for comparison purposes. By including both pressure and duration, energy flux density determines the cumulative energy over time from a noise source for its entire duration. Thus, longer sound durations generally result in higher total energy levels than similar

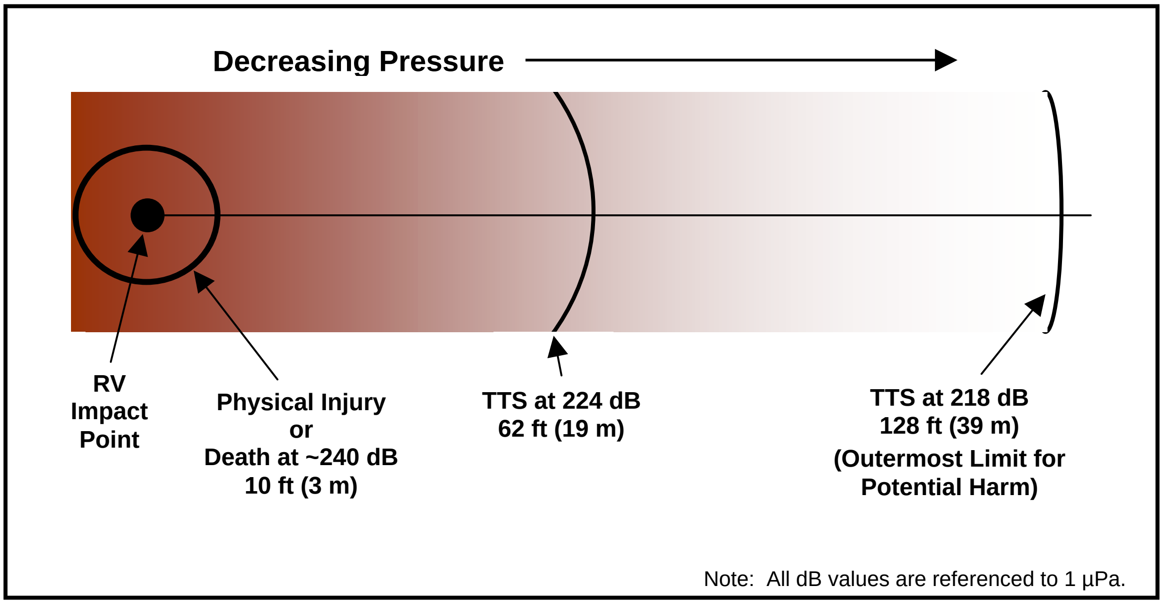


Figure 4-2. Illustration of Predicted Ranges for Underwater Shock/Sound Wave Impacts on Marine Mammals

Table 4-6. Number of Groups[1] of Marine Mammals that May Experience Temporary Threshold Shift (TTS), or Suffer Physical Injury or Death, from a Reentry Vehicle Impact

Sound Pressure Level (SPL) (dB ref to 1 µPa)	Sound Energy Flux Density[2] (dB ref to 1 µPa^{2}s)	Radial Distance from the Point of RV Disintegration [ft (m)]	Potential Effect	Number of Groups of Marine Mammals Exposed[3]
218	203	128 (39)	TTS [original limit by Ketten (1995)]	3.01E-06
224	209	62 (19)	TTS [new limit by Finneran, et al. (2002)]	4.52E-07
240	225	10 (3)	Physical Injury or Death	2.19E-07

Notes:

[1] Marine mammals occur in groups (pods or schools), and aerial and shipboard sightings of marine mammals are reported in units of groups rather than of individuals. Hence, group density rather than the density of individuals is the appropriate basis for estimating the risk of RV impacts to marine mammals. For analysis purposes, a single group is assumed to contain 10 to 12 animals.

[2] Sound energy flux density values were calculated in accordance to USN (2001b) and are described as: SPL + [10 x log(time in seconds)]. A conservative value of 30 milliseconds was used for the positive phase exposure duration.

[3] Estimations of TTS, physical injury, and death impacts are fully described in Ramanujam (2004), which can be found in Appendix B of this Final EA. Probabilities are based on marine mammal population densities for the PMRF sea range provided in Tytula (1998).

sound pressure levels of shorter duration. In the case of an RV impact, the resulting underwater shock/sound wave represents a single pulse of very short duration, having a maximum waveform rise time of about 30 milliseconds (Moody, 2004a).

When considering that (1) only three to four MM III launches are conducted every year, (2) RV target locations are not always the same, and (3) the probability for marine mammals and sea turtles to be impacted by underwater shock/sound waves is extremely low, the risk of animals being injured or killed is minimal. The fact that no dead or injured whales or other marine mammals have been reported to USAKA officials over the years of RV testing is evidence of this. To help ensure that marine mammals are not impacted by future RV tests, LLNL personnel will monitor the vicinity of Illeginni Island for marine mammals during helicopter flights to and from the island in the days and weeks leading up to each RV flight test. These results will then be reported to the USAKA Environmental Management Office, RTS Test Group, and the Flight Test Operations Director at Vandenberg AFB for incorporation into the launch prerequisite list, and for consideration in approving the launch.

As previously mentioned, airburst tests are performed at some altitude over water. The impact of the resulting RV fragments in the ocean or lagoon waters would present a much lower risk to marine life than an RV whole-body impact in the water. Additionally, the test RVs would be targeted farther away from Illeginni Island in order to minimize the drift of debris and fine particulates from the airbursts toward Illeginni, and to ensure that their impacts on plants and animals in the vicinity of the island would be insignificant.

In the event that an RV would directly impact on Illeginni Island or in the shallow coral reefs, a crater would form. Prior RV tests have resulted in craters on land averaging 20 to 25 ft (6.1 to 7.6 m) across and 15 ft (4.6 m) deep, depending on the type of substrate. Whether or not the test RV contains a high explosives package makes little difference in crater formation. Post-test operations on Illeginni require the manual cleanup and removal of any RV debris, including hazardous materials, followed by backfilling in larger craters on the island with soil (ejected around the rim of the crater) using a backhoe or grader. For impact craters along the shoreline, wave action will rapidly fill them in. (USAF, 1992a)

On Illeginni Island, RV impacts occur most often in cleared or maintained areas in the middle portion of the island, thus reducing the potential for migratory bird nesting areas to be adversely affected. Should an RV impact either an area occupied by migratory seabirds and shorebirds, any of the patches of littoral forest, or on sea turtle nesting habitat along the shoreline, birds and any other wildlife close to the point of impact could be killed, bird nests or sea turtle nests might be destroyed, and small areas of nesting habitat lost. Though other birds on the island would be startled and may flee the vicinity of the impact site, reactions are expected to be temporary, and nearby nests are not likely to be abandoned. Such impacts do not appear to be having any long-term effects on the migratory bird populations on the island. As mentioned before, bird populations on the island are thriving and may be increasing in numbers. The effects on sea turtle nesting sites is more difficult to predict, considering that few nest pits have been identified during surveys over the last several years (USFWS/NMFS, 2002).

Post-test cleanup and repair operations would also cause some additional, but short-term, disturbance in the area. Should an RV or RV debris impact within a littoral forest area or in other valuable habitats on Illeginni Island, the cleanup and backfilling of the crater would be accomplished utilizing protocols or best management practices developed by the USAKA, in consultation with appropriate agencies, to avoid and/or minimize additional impacts to such resources during the cleanup activities. For example, there would be no unnecessary disturbance of bird nesting sites, and in such areas, the least possible amount of vegetation and habitat would be disrupted.

If an RV impacts in the shallow reef flats near Illeginni, the resulting crater and post-test operations can damage the coral substrate and potentially harm reef fish and various marine invertebrates protected under the UES. In addition to the crater of up to 10 to 15 ft (3.0 to 4.6 m) in diameter, observations made by LLNL personnel at Illeginni have identified damage to the coral base up to 5 ft (1.5 m) beyond the rim of the crater in certain rare instances (Lindman, 2004). Any marine life in the immediate area would be killed or injured by the force of impact and blast-like effects. This would include the loss of both protected and non-protected species of coral, and any protected mollusks (e.g., top-snail shell and giant clam species) and sponges that might have existed at or adjacent to the crater site. However, after years of RV testing in the vicinity of Illeginni Island, most areas of the local reef appear to be thriving with moderate to high coral cover, and abundant numbers of invertebrates and fish present (USFWS/NMFS, 2002).

For RV impacts on the reef that result in craters being formed, USAKA, in consultation with USFWS and NMFS, would develop protocols to determine which craters should be filled and which should be left unfilled to avoid further impacts or disturbances to the reef. Post-test recovery and cleanup operations in shallow waters could require the movement of a backhoe or other equipment out onto the reef flats to the impact site. Any such movement of equipment would occur along predetermined routes to minimize environmental effects. For deeper waters in the ocean or lagoon, a ship with divers is used. Because craters form only in shallow waters less than 15 ft (4.6 m) deep, and no other damage to coral formations has been observed below 20 ft (6.1 m) (Lindman, 2004), RV impacts and post-test recovery operations in the deeper waters of the atoll lagoon and on the ocean side are much less damaging. In all cases, recovery and cleanup operations would be conducted in a manner to minimize any further impacts.

Though such impacts could potentially result in the loss of small areas of island and reef habitats, and some individuals of a protected species—an irreversible or irretrievable commitment of resources—the frequency of such occurrences would be very low (estimated to be four to five instances over a 20-year period), and the effects are considered to be temporary. Wildlife populations and habitat conditions would be expected to recover. A maximum of four MM III flights per year are targeted in the vicinity of Illeginni Island, and few test RVs ever impact directly on land or on the coral reef. In addition, targets are carefully selected to minimize the impact of RV flight tests on threatened and endangered marine mammals, sea turtles, migratory birds, and other marine life; and on the coral reef and island habitats. In particular, areas designated a habitat for species of concern, under the UES, would not be targeted. Considering the targeting accuracy and low frequency of such events, combined with implementation of those mitigation measures identified, no significant impacts to biological resources are anticipated.

In their biological opinion regarding effects on nesting habitat for green sea turtles (see Appendix D), the USFWS determined that the Proposed Action (along with reasonable and prudent measures, and conservation measures) is not likely to jeopardize the continued existence of the species. No critical habitat has been designated for this species; therefore, none will be affected. To compensate for potential impacts to sea turtle nesting and coral reef habitats at Illeginni, the USAKA, in cooperation with the RMIEPA, will establish a protected area for existing sea turtle nesting habitat on Eniwetak Island (located on the eastern side of USAKA), and the reef areas immediately surrounding the island. Eniwetak was selected on the basis of (1) the presence of active turtle nesting sites, and (2) the availability of viable enforcement options to protect the sea turtles and their nesting sites from poachers. For the protection of turtle nesting habitat, specific measures to be implemented at Eniwetak and Illeginni Islands, by USAKA and the USAF, are provided in the biological opinion. In their Incidental Take statement included in the biological opinion, the USFWS anticipates a loss of no more than three green sea turtle nests, or injury or loss of up to 300 hatchlings, per year as a result of project-related RV impacts at Illeginni Island. Though such losses are not likely to occur, it is expected that they would be offset by the implementation of conservation measures for turtle nesting habitat at Eniwetak.

While not planned or expected to occur, there is the slight possibility for RV impacts to occur on other uninhabited islands near Illeginni. Should such impacts ever occur, they would be similar in nature to those in the vicinity of Illeginni. In such cases, the same post-test cleanup and mitigation actions used at Illeginni would be applied.

As part of the DEP process described earlier in Section 1.7, the USAF will continue coordination and consultation with USAKA, the USFWS and NMFS Pacific Islands Regional Offices in Hawaii, USEPA (Region IX), and the RMIEPA, to clarify current mitigation measures and determine whether any additional mitigation measures are warranted.

4.5.1.2 Proposed Action

Sonic Boom Overpressures

The additional flight tests would be indistinguishable in acoustic properties from the RV flight tests already being conducted at USAKA. Consequently, the potential for impacts from sonic booms would be essentially identical to that described earlier for the No Action Alternative. Thus, no significant impacts to biological resources are anticipated.

Chemical Release

The potential impacts from the release of Be, DU, and other contaminants from the RV test components would be essentially the same as those identified for the No Action Alternative. As a result, no significant impacts to biological resources are expected.

Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

The proposed RV and post-boost vehicle splashdowns, and RV land impacts, would have essentially the same impacts as those described earlier for the No Action Alternative. As previously described in Section 4.5.1.1, the probability of marine mammals or sea turtles to be harmed by the resulting underwater shock/sound wave of an RV impact is minimal. Additionally, the loss of any protected species or habitat at Illeginni Island would be minimal and a temporary occurrence. Consequently, no significant impacts to biological resources are anticipated.

Under the Proposed Action, those mitigation measures identified in Section 4.5.1.1 for the No Action Alternative would be implemented. Additionally, consultations with the USFWS, NMFS, USEPA, and RMIEPA would continue as part of the DEP process.

4.5.2 Cultural Resources

4.5.2.1 No Action Alternative

Given the amount of fill and the extremely limited potential for any remaining traditional/prehistoric remains on Illeginni Island, the likelihood of impacts to any resources must be considered either non-existent or extremely low. In addition, there is little potential for Cold War-era buildings on Illeginni to be impacted by RV tests. Though not on the RMI List of Cultural and Historic Properties, the buildings have been well documented with photographic and written historical records as a pre-mitigation action (USASSDC/TBE, 1996), should any of them ever be altered or damaged as a result of RV tests or any other activities. As a result, little or no impact to cultural resources at Illeginni Island is expected.

4.5.2.2 Proposed Action

The proposed RV flight tests would not increase the level of impact on cultural resources at Illeginni Island. Just as with the No Action Alternative, little or no impact is expected.

4.5.3 Health and Safety

4.5.3.1 No Action Alternative

RVs launched from Vandenberg AFB would impact in the Mid-Atoll Corridor, either in the vicinity of Illeginni Island (an uninhabited island), or in the deep ocean waters east of USAKA. For these tests, safety procedures are in place and are practiced at USAKA with successful results.

Debris Hazards

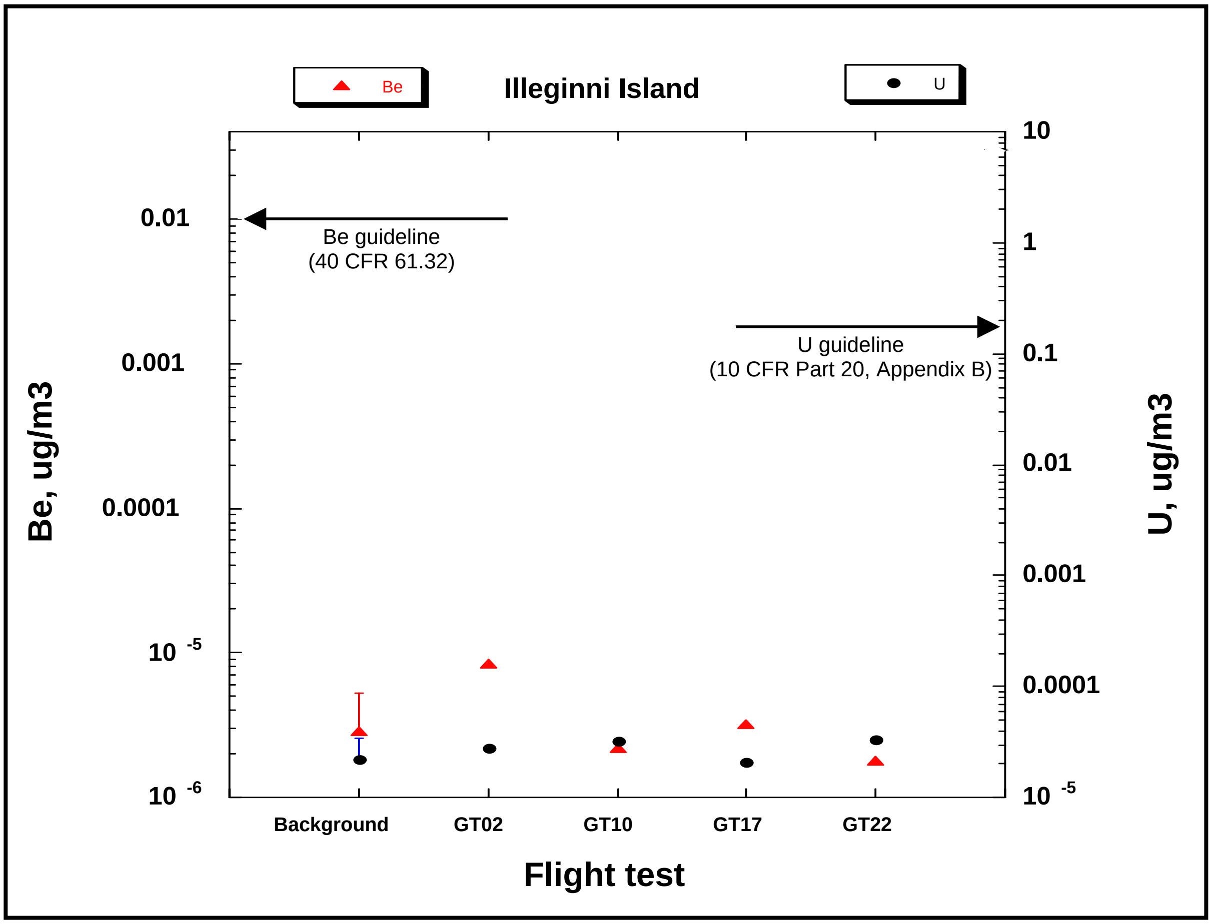
Protective measures would include sheltering inhabitants of "Take Cover" islands, evacuation of non-essential personnel from "Evacuation" islands, and evacuation of all personnel from "Debris Hazard" islands. A NOTMAR and a NOTAM would be published and circulated in accordance with established procedures to provide warning to personnel, including residents of the Marshall Islands, concerning any potential hazard area that should be avoided. Radar and visual sweeps of hazard areas would be accomplished immediately prior to operations to assist in the clearance of non-critical personnel. Only mission-essential personnel would be permitted in hazard areas (USASSDC, 1995), though all personnel are excluded from the vicinity of Illeginni Island during RV tests in that area. Because of the safety procedures that are in place, that each MM III test flight would be preceded by flight safety analyses (as described in Section 3.5.3), and that the sensing and tracking of test RVs at USAKA has been previously analyzed (USASSDC, 1993), no significant impacts to health and safety are anticipated.

Release of Hazardous and Toxic Materials

As described previously, an airburst or ocean/lagoon impact by some test RVs would disseminate on-board hazardous and toxic materials—primarily Be and DU—around the impact point and some distance downwind. For a land impact on Illeginni, such debris occurs close to the point of impact, mostly within a 328-ft (100-m) radius. As a result, the major potential health concern of these tests is the subsequent effects on USAKA workers, and other agency and contractor personnel, whose occupations require visits to the island, and the long-term management and restoration of the island. The concentration of Be and DU in the air is elevated for only a brief period of time following the RV impact. Direct measurements of previous test results have provided sufficient information to conclude that there would be no potential health effects in the immediate vicinity of the tests, and that no air quality criteria would be exceeded anywhere for surface impacts or airburst tests. The long-term concentrations in air from resuspension is more than a factor of 10,000 lower than the 30-day emission standard for Be, and the 1-year standard for Uranium (U)[14]. (USAF, 1992a)

Long-term environmental sampling and monitoring of RV tests at Illeginni have shown that there would be no potential health effects in the immediate vicinity of the surface impact or airburst tests, and that no air quality criteria for Be and U would be exceeded. Figure 4-3 shows the post-test air sampling results for Be and U from four RV flight tests conducted in the vicinity of Illeginni Island from 1992 to 1995, compared to USEPA and US Nuclear Regulatory Commission guidelines, and background levels recorded prior to the flight tests. Post-test values shown represent maximum averages taken using an array of air samplers over an approximate 6-week period.

[14] See footnote 1.



Source: Lindman, 2004; Terrill, 2003

Figure 4-3. Reentry Vehicle Post-Test Air Sampling Results for Beryllium and Uranium at Illeginni Island (1992–1995)

For the post-test recovery and cleanup of RV debris from Illeginni Island or in the shallow waters of the lagoon, USAKA personnel and contractors follow established safety procedures. When tests are conducted using DOE-developed RV simulators, representatives from LLNL in California are also involved to support recovery and cleanup operations for any remaining hazardous materials, in particular, Be and DU. In such cases, special safety procedures, identified in LLNL Operational Safety Procedure 161 [*Joint Test Assembly (JTA) 300 Series Flight Test*], are applied. These procedures detail safety controls for personnel before, during, and after recovery operations. They include personnel training; securing the impact area and areas immediately downwind from inadvertent helicopter, boat, or vehicle traffic until the soil deposition is stabilized by wetting, and the helipad has been washed or swept; use of personal protective equipment; sampling; and environmental monitoring (Lindman, 2004). A list of mitigation measures that have previously been applied to pre- and post-test monitoring, recovery, and cleanup activities at Illeginni is included in Appendix A. An expanded list of mitigation measures for all future testing is presented in Section 4.7.

4.5.3.2 Proposed Action

Debris Hazards

For each flight test, the RV would impact in the same general area used for current FDE launches under the No Action Alternative (Figure 2-12). The safety procedures conducted at USAKA would be identical to those conducted for ongoing activities. As with the No Action Alternative, each RV test flight would be preceded by flight safety analyses, as described in Section 3.5.3. Thus, no significant impacts to health and safety are anticipated.

Release of Hazardous and Toxic Materials

The proposed RV flight tests would have essentially the same impacts as those described earlier for the No Action Alternative. Just as with prior tests, air concentrations of Be and U would not exceed US Federal guidelines, and should remain near natural background levels following each test. The same safety procedures previously described for post-test recovery and cleanup operations would be followed for all proposed RV tests at USAKA.

4.5.4 Hazardous Materials and Waste Management

4.5.4.1 No Action Alternative

Other than fuels and lubricants for operating transportation and cleanup equipment, there is limited use of hazardous materials at USAKA in support of the MM III flight tests. For the use of such common materials, the procedures identified in Section 3.5.4 are followed. The impacts of RV simulators from ICBM flight tests, however, represent unique missions with special hazardous material and waste management requirements.

Though it is very unlikely for buildings on Illeginni Island to be impacted by RV tests, the USAKA has removed any remaining hazardous materials and wastes [e.g., asbestos, polychlorinated biphenyls (PCBs) in old light ballasts, and cans of paint] from the abandoned buildings as a pre-mitigation action (Sims, 2004). This action eliminates any concerns for the potential release of such materials into the environment during RV tests or any other activities conducted there.

Depending on mission requirements and system design, some test RVs may contain varying quantities of DU, Be, high explosives, and other hazardous materials. A specific design may contain any combination of these materials or none. Also, some materials may be classified. For the post-test recovery and cleanup of such hazardous materials from the vicinity of Illeginni Island, procedures identified in LLNL's *JTA 300 Series Recovery Plan for US Army Kwajalein Atoll, Illeginni Island* (1992) are used (Lindman, 2004). Specific procedures in this plan address:

- Surveying the impact crater
- Use of recovery equipment, including screens and heavy machinery
- Collecting visible debris
- Documenting recovery data
- Characterization and mitigation of residual levels of DU and Be.

Near the impact crater, precautions are taken to secure the area from inadvertent traffic until recovery is completed, protect workers from respiratory exposure, and recover any metal fragments. Normally, such cleanup operations are conducted by LLNL and USAKA personnel over an approximate 2-day period.

Should any residual high explosive materials be found, all activity is halted until the USAKA explosives ordnance disposal team is brought in to remove or mitigate the hazard. (Lindman, 2004)

Any RV fragments collected are packaged in one or more 55-gal (208-L) drums. The drums are transported to Kwajalein Island and then shipped directly to LLNL in California via USAF air cargo transport and LLNL ground transportation. There, the debris is evaluated and then disposed of in accordance with DOE/LLNL regulations and procedures. Specific requirements for the packaging, handling, staging, and transportation of the resulting debris are provided in LLNL's *JTA 300 Series Recovery Shipping Procedure* (1992). (Lindman, 2004)

For attempts made to recover both MM III and Peacekeeper RV debris at USAKA between 1990 and 2003, the approximate quantities of materials collected are shown in Table 4-7. Because of the hypersonic velocity of RVs at impact, DU components are broken into small fragments and/or aerosolized. All of the Be-containing components are aerosolized because of the composition of the material; thus, no Be has been recovered. No attempts have been made to recover RV debris from deep ocean waters. (Lindman, 2004)

Table 4-7. Recovered Debris from Reentry Vehicle Impacts in the Vicinity of Illeginni Island (1990–2003)

Debris Recovery Location	DU Fragments lb (kg)	Other Fragments* lb (kg)
Land (including shallow lagoon and ocean reef flats)	176 (80)	124 (56)
Atoll Lagoon (north of Illeginni)	97 (44)	31 (14)

*Includes heat shield, metal alloys, and other non-DU fragments. No Be fragments have been collected.

Source: Lindman, 2004

A few weeks after each RV test, following the completion of all recovery and cleanup operations, LLNL personnel would set up air samplers, as necessary, to determine the presence of any Be and DU contaminants in the air. Air samplers are usually operated over a period of 6 to 8 weeks to demonstrate that there has not been a net change to the environment at Illeginni. Factors determining air-sampling requirements are impact location, wind direction at the time of impact, and the type of RV design. LLNL also continues to monitor the concentrations of Be and DU in the soil on Illeginni. Removal of the top 0 to 2 inches [0 to 5 centimeters (cm)] of soil would be required if concentrations exceeded established standards. As previous sampling results have shown, levels of Be and DU contaminants in the air at Illeginni Island continue to remain at or near background levels, even after years of conducting RV tests in the area. Be and DU soil concentrations on the island can exceed background levels in the vicinity of RV impact sites. However, the Be and DU concentrations in the dissolved form are below background levels. In addition, the rates of dilution for Be and DU are significantly greater than their rates of dissolution in water, ensuring that the concentrations would not exceed background levels.

For the reporting of sampling efforts, LLNL will transmit the test results on Be and DU concentrations in the air and soil to the USAKA Environmental Management Office within 6 weeks from the date of sampling. USAKA is then responsible for transmitting the records to the RMI Government within 2 weeks from the date of receipt, through the established channels approved by the US State Department.

Because of the regulations and procedures in place at USAKA, and since little or no accumulation of hazardous materials in the air and soils from RV tests has occurred on Illeginni Island, no adverse impacts from the management of hazardous materials and waste at USAKA are expected.

The targeting of RVs in the vicinity of Illeginni Island is highly accurate and reliable. As previously mentioned, it is unlikely that RV flight tests would impact other uninhabited islands near Illeginni. Should such impacts ever occur, they would be similar in nature to those at Illeginni. In such cases, the same post-test cleanup and mitigation actions, as previously described for Illeginni, would be applied.

4.5.4.2 Proposed Action

For proposed MM III FDE flight tests, post-test RV recovery and cleanup operations at USAKA would be conducted in a manner similar to that identified in Section 4.5.4.1, above, for the No Action Alternative. Also, the four additional RV flight tests planned in the FYs 2005 and 2006 timeframe would not exceed current waste recovery or handling capacities, and are not expected to cause any increase in Be or DU levels in the soil at Illeginni Island. As a result, there would be no adverse impacts from the management of hazardous materials and waste.

4.6 CUMULATIVE EFFECTS

Cumulative effects are considered those resulting from the incremental effects of an action when considering past, present, and reasonably foreseeable future actions, regardless of the agencies or parties involved. In other words, cumulative effects can result from individually minor, but collectively potentially significant, impacts occurring over the duration of the Proposed Action and within the same geographical area.

The potential for cumulative impacts to occur at each of the locations proposed for use during the MM III modification is discussed in the following paragraphs.

FE Warren, Malmstrom, and Minot Air Force Bases

The transportation and handling for four additional boosters over 2 years, in support of flight tests at Vandenberg AFB, would not result in a substantial increase in risk to the public or to USAF personnel, nor would it have any measurable affect on the frequency of vehicular accidents on public roads and highways. Also at FE Warren AFB, the overall risk to the public and to USAF personnel is expected to decrease once the Peacekeeper ICBMs are all deactivated from service in 2005. In regards to the deployment of RS modification kits and Mark 21 RVs at all three Wings, activities would be conducted during normal ongoing maintenance operations, within existing facilities established for such operations. Because no additional health and safety issues would result, and established safety procedures and regulations would continue to be followed, no significant health and safety cumulative effects are anticipated.

Similarly, no significant additional or new hazardous materials would be handled or hazardous wastes generated during this RS modification process, nor would the replacement of command and control console equipment at the LCCs exceed waste handling capacities at each base. Thus, no significant hazardous materials or waste cumulative effects are anticipated.

Hill Air Force Base

Assembly of the replacement MM III boosters at Hill AFB would be conducted within existing facilities, in the same manner as for the No Action Alternative. In addition, similar operational support requirements for the Peacekeeper ICBM program would end in 2005, following system deactivation. As a result, no significant cumulative impacts to health and safety are anticipated.

Likewise, no significant additional or new hazardous materials would be handled or hazardous wastes generated during assembly of the replacement MM III booster. The replacement of command and control console equipment also would not exceed current waste handling capacities at Hill AFB. Consequently, no significant hazardous materials and waste cumulative effects are anticipated.

Vandenberg Air Force Base

The proposed MM III flight tests at Vandenberg AFB would be conducted in a manner similar to current flight tests. Moreover, they would occur from the same four LFs that are routinely used now. Table 4-8 shows that the four additional MM III flight tests would represent a 33 percent increase in FY 2005, and a 29 percent increase in FY 2006, over launches forecasted for ongoing programs. Launch rates for other years would not change as a result of the Proposed Action.

Table 4-8. Ballistic (Non-Orbital) Missile Launch Rate Forecast for Vandenberg AFB

Launch Program	Fiscal Year							
	2003	2004	2005	2006	2007	2008	2009	2010
MM III FDE*	3	3	3	3	4	4	4	4
Additional MM III Flight Tests*	0	0	2	2	0	0	0	0
Peacekeeper FDE*	1	1	1	0	0	0	0	0
BMDS**	3	2	2	4	2	2	2	2
Total Launches	**7**	**6**	**8**	**9**	**6**	**6**	**6**	**6**

Notes:
FDE = Force Development Evaluation
BMDS = Ballistic Missile Defense System
MM = Minuteman
*All program launches would be conducted from the Minuteman Launch Area on North Vandenberg AFB.
**Most program launches would be conducted from the Minuteman Launch Area on North Vandenberg AFB.
Sources: Ogden ALC, 2003; SMC, 2003

The projected increase in launch activity at Vandenberg AFB has the potential for additive, cumulative air quality impacts over the 2005 to 2006 period. However, launch vehicle exhaust products, and other launch operation emissions, do not accumulate because winds quickly and effectively disperse them between missions. In terms of upper atmospheric effects, emissions released into the upper atmosphere would add to the overall global loading of chlorine and other gases that contribute to long-term ozone depletion. However, the amount of emissions released from rocket motors is negligible compared to losses of ozone from other global sources. Because the emissions would represent an extremely small percentage of total loading, they should not significantly contribute to the cumulative impact on stratospheric ozone. Consequently, no significant cumulative impacts to air quality are anticipated.

The projected increase in launch activity at Vandenberg AFB has the potential for cumulative impacts to the noise environment. However, despite the relatively high percentage increase in launches from North Vandenberg, the increase in the rate of launches—from six to eight launches in FY 2005, and from seven to nine launches in FY 2006—would not have any perceptible impact on cumulative noise metrics, such as the CNEL.

For biological resources at Vandenberg AFB, the increase in noise exposure from more launches would result in some noise impacts, especially for the sensitive marine mammals, shore birds, and other protected species occurring along the coastline and immediately offshore. However, the relatively sparse distribution and the seasonality of many species in the area combine to make the probability of significant adverse cumulative impacts extremely low. Additionally, the increase in launch operations is not expected to alter the number of "takes" per year authorized under Vandenberg AFB's current 5-year NMFS incidental take permit governing marine mammal harassment.

In terms of health and safety, because of the limited scope and duration of added activity, and the proven safeguards in place, no significant cumulative impacts to health and safety are expected at Vandenberg AFB. Established safety procedures and regulations would continue to be followed.

No new hazardous materials and waste would be introduced, and only a small increase in wastes would occur, from the additional flight tests at Vandenberg AFB. The replacement of command and control console equipment also would not exceed current waste handling capacities on base. Therefore, no significant cumulative impacts from the management of hazardous materials and waste are anticipated.

In addition to the rocket launches associated with other programs, other activities are occurring within the Minuteman Launch Area. The Missile Defense Agency (MDA) is in the process of establishing an initial missile defense capability at Vandenberg AFB, which is expected to begin operation in December 2004. Construction and modifications at four other existing MM silos in the area—including launch tube and enclosure modifications, exterior lighting, and security fencing—is near completion. The process of installing Ground-Based Interceptor (GBI) missiles in the silos is ongoing. Previously analyzed in the *Ground-Based Midcourse Defense (GMD) Initial Defensive Operations Capability (IDOC) at Vandenberg Air Force Base Environmental Assessment* (MDA, 2003), this new missile system will provide an initial defense against a limited long-range ballistic missile attack. Though the increased activity of establishing and maintaining the GBI launch facilities, along with the added MM III launch operations analyzed in this EA, will have some cumulative affect in dispersing local wildlife within the Minuteman Launch Area, the overall effects are expected to be minor and mostly short-term.

Over-Ocean Launch Corridor

Potential cumulative impacts could occur from the four additional MM III flight tests, over and above projected FDE and other flight tests identified in Table 4-8. Though sonic booms could lead to hearing loss in marine mammals and sea turtles, the noise levels are of very short duration and the resulting underwater peak pressures caused by MM III launches are expected to be well below TTS levels. There is a slightly higher risk for missile debris to strike marine life along the flight corridor, but again, protected marine species are widely scattered and the probability of debris striking a marine mammal or sea turtle is considered very remote. The resulting shock/sound wave produced by the spent rocket motors when they impact in the water could cause injury or death to animals close to the impact point, and also lead to potential temporary hearing loss in animals farther away. However, the probability for such an occurrence is very low, considering the minimal number of tests conducted annually, the relatively low population distribution of animals in the open ocean, and the small size of the areas affected with each test. Thus, no significant cumulative impacts to biological resources are anticipated.

US Army Kwajalein Atoll

Over years of conducting both MM III and Peacekeeper FDE flight tests, potential cumulative impacts to biological resources at USAKA could result from direct impacts to Illeginni Island, the atoll lagoon, and the ocean waters offshore of Kwajalein Atoll. The additional RV flight tests targeted within the Mid-Atoll Corridor could impact threatened and endangered sea turtles and marine mammals as a result of sonic boom overpressures, chemical release and water contamination, and direct contact and shock/sound wave from the splashdown of missile components. However, the relatively sparse distribution of marine mammals and sea turtles in the area makes the probability of significant adverse cumulative impacts on such species low. For RV tests conducted at Illeginni Island, incidental takes of some migratory birds are possible, in addition to the loss of some protected reef species (e.g., sponges, corals, and mollusks) and fish. Such tests can also damage migratory bird habitat, sea turtle nesting habitat, and coral reef habitat. However, the resilience of native vegetation and migratory bird populations on Illeginni to thrive after years of operations and testing shows that there are minimal long-term adverse affects, if any. The same also applies to the coral reef habitat, which remains diverse and generally in good health, with the exception of one particular area where moderate turbidity in the water column has been noted and the health of the reef adversely affected. The source of degradation is not known. However, the USAF, through USAKA support, has sampled various locations on and around Illeginni Island where RVs have previously impacted. Once complete, the sampling results will be used in determining the need for further consultations with the USFWS, NMFS, and RMIEPA, and if additional mitigation measures are warranted.

Peacekeeper ICBM flight tests will end in 2005 at the completion of system deactivation, which will reduce the number of test RVs targeted in the vicinity of USAKA. As shown in Table 4-9, the total number of test RVs that would impact at or near USAKA would decrease substantially in later years, well below historical test rates. Because the proposed RV tests occur only a few times per year, and since the same areas are normally not impacted with each flight, significant cumulative impacts to biological resources are not expected.

Table 4-9. Reentry Vehicle Flight Test Rate Forecast for US Army Kwajalein Atoll

Launch Program	Fiscal Year							
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Minuteman III RVs	8	6	9	7	6	5	6	4
Peacekeeper RVs	8	8	8	0	0	0	0	0
Total Number of RVs*	**16**	**14**	**17**	**7**	**6**	**5**	**6**	**4**

Notes:
*All test RVs carried on MM III and Peacekeeper missiles would be targeted in the vicinity of USAKA.
Source: Miyamoto, 2004

Procedures used at USAKA for the Proposed Action would be identical to those conducted for ongoing activities, and the proposed flight tests targeted at the atoll would be well within the range's capacity for operation. Also, as prior monitoring efforts have shown, air contaminant (Be and DU) levels at Illeginni Island continue to remain at or near background levels, even after years of RV testing in the area. Though soil concentrations of Be and DU, in the vicinity of RV impacts on the island, can occur above background levels, their concentrations in the dissolved form are below background levels. In addition, the rates of dilution for Be and DU are significantly greater than their rates of dissolution in water, ensuring that the concentrations would not exceed background levels. As a result, no significant cumulative impacts to health and safety, or from the management of hazardous materials and waste, are anticipated.

4.7 SUMMARY OF MITIGATION MEASURES, IMPLEMENTATION DETAILS, AND RESPONSIBILITIES

Throughout Chapters 2.0, 3.0, and 4.0 of this EA, various management controls and engineering systems for all locations affected are described. Required by Federal, state, DOD, and Service-specific environmental and safety regulations, and international agreements, these measures are implemented through normal operating procedures.

From earlier discussions, specific mitigation measures and monitoring activities have been identified to minimize the level of impacts that might occur at USAKA as a result of the planned RV flight tests. Grouped by responsible organization, these mitigation measures and monitoring activities are listed below, including the relevant sections of the EA where they apply. DOE/LLNL will provide the leadership for the implementation of the Group 1 mitigation measures. The USAKA Environmental Management Office will provide the leadership for the implementation of the Group 2 mitigation measures. DOE/LLNL and the USAKA Environmental Management Office will coordinate and consult with the ICBM System Program Office, Air Force Space Command (AFSPC), USFWS, NMFS, and the RMIEPA, as necessary, in the implementation of the mitigation measures. Funding for the mitigation measures and the monitoring of their effectiveness will be a joint and shared responsibility of DOE/LLNL, ICBM System Program Office, AFSPC, USASMDC, and the USAKA Environmental Management Office.

Group 1—DOE/LLNL

1) Exclude personnel from the vicinity of Illeginni Island during tests in that area (Section 4.5.3).
2) Protect personnel from exposure during post-test operations near the impact crater (Section 4.5.3).
3) Maintain exclusionary control near a land impact crater and downwind of the crater prior to recovery action (Section 4.5.3).
4) Recover parts and debris as much as reasonably prudent near the impact crater, to include collecting visible debris from the RV that is in the crater and on the island. Excavate the impact crater to recover small particle RV debris after scoring and mapping operations are complete. Use standard USAKA/LLNL procedures [*JTA 300 Series Recovery Plan for US Army Kwajalein Atoll, Illeginni Island* (1992)] involving screening and washing of material removed from the crater. (Section 4.5.4)
5) Minimize helicopter and vehicular traffic in the vicinity of a land impact crater until the soil deposition is stabilized by wetting, and the helipad has been washed or swept down (Section 4.5.3).
6) Conduct sampling of the air and soil to ensure that the concentration in air of Be and of DU does not exceed established standards. Removal of the top 0 to 2 inches (0 to 5 cm) of soil would be required if concentrations exceeded established standards. (Sections 4.5.3 and 4.5.4)
7) Maintain necessary surveillance of the cumulative effect from repetitive tests to ensure that the criteria listed in item (6) are maintained (Section 4.5.4).
8) Maintain records of Be and DU concentrations in air and soil to document the tests results, and transmit them to the USAKA Environmental Management Office within 6 weeks from the date of sampling (Section 4.5.4).
9) Avoid unnecessary disturbance of migratory bird nests (Section 4.5.1). (See also measure 14.)
10) Refill any land crater in a manner that is least damaging to the environment (Section 4.5.1), with precautions taken to avoid exposure of personnel to any hazardous levels of Be and DU (Section 4.5.3).
11) Should an RV impact within one of the littoral forest areas on Illeginni or elsewhere in the vicinity, the least possible amount of vegetation and habitat would be disrupted for equipment access and cleanup operations (Section 4.5.1). (See also measure 14.)

12) Perform opportunistic marine mammal monitoring in the vicinity of the Illeginni Island from the helicopter flights to and from the island during the days and weeks leading up to a scheduled MM III flight test, and report the results to the USAKA Environmental Management Office, RTS Test Group, and the Flight Test Operations Director at Vandenberg AFB for incorporation into the launch prerequisite list, and for consideration in approving the launch (Section 4.5.1).

Group 2—USAKA Environmental Management Office

13) Develop protocols or best management practices, in consultation with the appropriate agencies, to determine which craters should be filled and which should be left unfilled to avoid further impacts or disturbances to the reef, following RV impacts on the reef. Any such movement of equipment would occur along predetermined routes to minimize environmental effects. (Section 4.5.1)
14) Develop protocols or best management practices, in consultation with the appropriate agencies, for the cleanup and backfilling of craters in littoral forests, or in other valuable habitats, by incorporating methods and procedures that would avoid and/or minimize additional impacts to such resources during the cleanup activities. (Section 4.5.1)
15) USAKA, in cooperation with the RMIEPA, will establish a protected area for existing sea turtle nesting habitat on Eniwetak Island (located on the eastern side of USAKA), and the reef areas immediately surrounding the island, in order to compensate for potential impacts to sea turtle nesting and coral reef habitats at Illeginni. Eniwetak was selected on the basis of (a) the presence of active turtle nesting sites, and (b) the availability of viable enforcement options to protect the sea turtles and their nesting sites from poachers. The details of the protected area to be established will be defined through the DEP process. (Section 4.5.1)
16) USAKA will transmit the records of Be and DU concentrations in air and soil to the RMI Government within two weeks from the date of receipt of such records from DOE/LLNL through the established channels approved by the US State Department (Section 4.5.4).
17) Based on existing data, definitive conclusions on risks to animal species and human health cannot be reached. For this reason, soil, sediment, and tissue samples have been taken at Illeginni Island, and along the shorelines and shallow marine environments of the lagoon and ocean side of the island. Though the sampling effort at Illeginni has already been completed, the analytical results for the samples collected are not expected until late 2004. Once the sampling results are known, the information will be utilized in determining the need for further investigation in consultation with the USFWS, NMFS, USEPA, and RMIEPA, and if additional mitigation measures are warranted. Based on sample analyses, and other new information as it becomes available, strong consideration will be given to further investigation of associated risks. (Section 4.5.1)

As part of the DEP process described earlier in Section 1.7, the USAF will continue coordination and consultation with USAKA, the USFWS and NMFS Pacific Islands Regional Offices in Hawaii, USEPA (Region IX), and the RMIEPA to clarify current mitigation measures and determine whether any additional mitigation measures are warranted.

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